THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 47. Thursday, October 6, 1932. No. 842.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of
THE FOUNDRY TRADE JOUPNAL,
49, WELLINGTON STREET, LONDON, W.C.2.
Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (6 lines).

Contents.

	PAGE
Forthcoming Events	197
Trade Barometers	197
A Further Step	197
Correspondence	198
District Presidents.—No. 8	198
The Lancastrian Club	198
Random Shots	198
A Proposed British Foundry Technical Training College	199
American Society for Testing Materials	200
A Conservative Industry	201
Heat-Treated Alloy Cast Iron	203
Catalogues Received	203
Scale Removal by Acid Pickling	204
Nickel Cast Iron in Diesel Engines	206
Book Reviews	209
Iron and Steel Institute	209
Institute of Metals	209
This Week's News in Brief	210
Trade Talk	210
Obituary	210
Personal	210
Raw Material Markets	212
Contracts Open	212
New Companies	212

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT: 1932-33:
Victor Stobie, M.I.E.E., Langholm, South Drive, Harrogate.

LIST OF SECRETARIES—
General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office: 49, Wellington Street, London, W.C.2.
Birmingham, Coventry and West Midlands: L. W. Bolton, 21-23, St. Paul's Square, Birmingham.
Sheffield: T. R. Walker, 33, Ladysmith Avenue, Nether Edge, Sheffield.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
Lancashire: J. E. Cooke, 1, Derbyshire Crescent, Stretford, Manchester.
London: H. W. Lockwood, Stewarts & Lloyds, Limited, Winchester House, Old Broad Street, London, E.C.2.
Newcastle-upon-Tyne: J. W. Eckford, 4, Mosley Street, Newcastle-upon-Tyne.
East Midlands: H. Bunting, 82, Otter Street, Derby.
West Riding of Yorkshire: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.
Wales and Monmouth: J. J. McClelland, 12, Clifton Place, Stow Hill, Newport, Mon.
Middlesbrough: F. A. Harper, "The Briars," Bishopton Road, Stockton-on-Tees.

Foundry Trades' Equipment and Supplies Association.

President: D. H. Wood,
Titan Works, Charles Henry Street, Birmingham.
Secretary: K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 2, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION.

The Registered Office and Laboratories of the B.C.I.R.A. are at:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM.
Telephone: Central 1895. Telegrams: CIRA.
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (Telephone 322).

Forthcoming Events.

OCTOBER 11.

Institute of Metals (Swansea Section):—Ordinary meeting. "Refractory Materials and the Non-Ferrous Industries," Paper by Alfred B. Searle.

Sheffield Metallurgical Association:—Iron and Steel Institute additional meeting at Sheffield.

OCTOBER 13.

Institute of Metals (London Section):—Ordinary meeting in London. Address by S. L. Archbutt.

Institute of Metals (Birmingham Section):—Symposium on Hardness Testing.

OCTOBER 14.

Institute of Metals (Sheffield Section):—Chairman's address on "Annealing," by Capt. F. Orme, M.Met.

Institute of British Foundrymen.

OCTOBER 3.

Lancashire Branch (Burnley Section):—Ordinary meeting. "Some Notes from Previous Lectures on Foundry Practice." Paper by E. Longden.

OCTOBER 13.

London Branch:—Ordinary meeting. "Some Observations on the Character of Cast Iron," Paper by A. C. Vivian.

Trade Barometers.

The science of business forecasting, which some few years ago promised to be of such great help to industrialists in enabling them to forecast the trend of business, is, at present, somewhat under a cloud, largely on account of the lamentable failure of the experts to predict the length and depth of the present depression. We feel, however, that the experts cannot altogether be blamed for this, because the normal ebb and flow of business has been interfered with to such a large extent by politicians and governments all over the world, who have had, in what they believe to be their own interests, to take steps to add to the variety of the forces which control world trade.

The publication of Papers given at the British Association nearly a year ago on this question has brought out some extremely interesting points. One which struck us particularly was the way in which the earnings of companies in a given line of business fluctuate together, irrespective of their individual contributions to the industry as a whole. The earnings over a period of seven years of the various sections of the electrical industry are singularly alike in their fluctuations, and similar to the average for the whole. This, of course, emphasises the point that there are world factors which influence trade and industry which are beyond the control of any particular company.

A second chart, of the greatest possible significance, gives the decline in British manufactured exports compared with imports. The decline for the last ten years has been most marked, and it suggests that sooner or later this country will be compelled to arrange its international purchases in accordance with the directions in which the manufactured exports go. It also suggests, what has been said by a number of Government Commissions and Committees, that, relatively, this country is losing ground at a rate not wholly accounted for by the world depression, by political conditions and other extraneous factors, and that this can only be met by business courage, enterprise and foresight which, at present, must in some respects be lacking. It seems that the entirely artificial demand for goods which existed over the war period had, to some extent, spoiled us for manufacture in a period of intense competitive activity. It also suggests that improvement in trade conditions in this country will be governed, perhaps more than it should be, and possibly even dictated by the recovery in other countries.

These reflections are not very consoling to our national pride, but it is all to the good that we should know the facts and arrange accordingly the best way to meet them. It is our national characteristic that we can only be persuaded to act when a state of emergency has arisen, but, fortunately, when that has been demonstrated beyond question, the response is usually certain.

A Further Step.

Elsewhere in this issue Mr. V. C. Faulkner has outlined the steps necessary to be taken for the establishment in Great Britain of a specialised department for foundry practice within the University of Birmingham. After listening to his remarks, a resolution was passed asking the Council of the Institute of British Foundrymen to examine the proposals set forth therein. We are not at all sure that the time is ripe for such a development. For several years the Institute has been working upon the creation of curricula for and issue of certificates to successful candidates in courses of study covering foundry practice of two kinds—one for trade lads and one for high-grade technicians. Whilst there is every indication that that success will attend the work, spread over several years of the Institute's Education Committee, it is still too early to pass judgment. If it is felt that if the creation of a specialised school of foundry practice would help in the provision of teachers for district technical schools and candidates for the advanced certificate, then such a scheme would be worth while. After all, the main object of the scheme is the formation of a limited number of enthusiastic specialists who, by reason of their training, cannot possibly help but create throughout the whole industry a desire to understand the parameters of foundry practice. Though these individuals are to receive a training specially designed to fit them for the more important executive positions in the industry, they will be unable to prevent themselves from disseminating the knowledge they have gained from their training, through the normal channels made by previous and present generations of foundrymen.

The scheme put forward is of a sketchy character, but if any point has been emphasised that is of outstanding importance, it is that of the real necessity for the co-operation of the various employers' federations within the industry. If the foundry industry plays its cards well, we should see within the next two decades a faculty of foundry practice with its dean and professors for its engineering and metallurgical branches. That is the ideal constantly to be borne in mind.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Coal-Dust Bond.

To the Editor of The Foundry Trade Journal.

Sir,—I have read with great interest the article by Mr. Hird on coal-dust bonded sand, on which I offer my congratulations. I should like to place before your notice some experience I have gained with a large plant of which I have charge in the mixing and use of moulding and facing sands by a synthetic process.

Bond is required for holding the grains of sand together whilst moulding and coal dust for producing carbon to coat the grains to prevent the liquid metal from burning on. It is now apparent that tar produced from coal dust does hold the grains together whilst in the casting process, but how is it that when only burnt sand or backing sand is used on light castings no coal dust is needed, yet a clean, smooth blue skin is the result, and which can be obtained if an alternative bond is added to black sand to keep the grains together. Regarding your statement in the latter part of your article, "Does it reveal a method for reclamation of burnt oil-sand cores?" I can assure you a system already exists in this country for that purpose. The end of cores made from oil-sand cores after casting from oil cores are used afterwards instead of new moulding sand for mixing of facing sand by a synthetic process. My firm not having hitherto done this, I carried out experiments, with the result that tons of oil-sand cores which would be dumped are re-used instead of new sand.—Yours, etc.,

F. C. Barker.

Chelmsford,
October 1, 1932.

Book Review.

Kelly's Directory of the Engineering, Hardware, Metal and Motor Trades, 1932. Published by Kelly's Directories, Limited, 186, Strand, London, W.C.2. Price 45s. post free.

A feature which we invariably admire in major publications of Kelly's Directories is the excellent binding they use. This book, for instance, is 5 in. thick, and the strain on a binding over a period of two years is greater than most people imagine. That the book has grown is indicated by the fact that the last edition was 4¼ in. thick. In general terms, this book covers England, Scotland and Wales, and as founders sell to every type of manufacturer they cannot help but find ideas for the extension of their business if they intelligently study British resources as disclosed by this directory. Primarily, there is a geographical list of firms, arranged by county, town and village. This is followed by an alphabetical classification of trades for the London postal area, and, finally, a similar classification for the rest of England, Scotland and Wales. In addition, there is a list of some 10,000 branded articles and proprietary specialities, giving the names and addresses of the owners of these brands; an alphabetical list of the manufacturers of steel sections, with the range of sizes made by each, and a list of iron and steel brands. The metamorphosis which industry is at the moment undergoing makes the appearance of a new edition of this directory very welcome.

Aluminium Analyses.—The Aluminium Research Institute has issued a Report giving details of standard methods for sampling and analysing aluminium and certain aluminium alloys.

District Presidents.—No. 8.

SHEFFIELD SECTION OF THE INSTITUTE OF METALS.

Capt. Fred Orme, M.Met., A.I.C., chairman of the Sheffield Local Section, Institute of Metals, first studied the metallurgy of iron and steel under the late Prof. Arnold. He graduated with honours at Sheffield University in 1914, and was awarded the Mappin Medal and Premium.

Capt. Orme served overseas with the Northumberland Fusiliers throughout the war, and on demobilisation returned to Sheffield University to take up the appointment of Demonstrator in Metallurgy. He is at present Lecturer in Non-Ferrous Metallurgy in the University of Sheffield, an appointment which

Capt. Fred Orme, M.Met., A.I.C.

(Chairman of the Sheffield Branch of the Institute of Metals).

he has held since 1922. He was elected a member of the Institute of Metals in 1919, is also a member of the Iron and Steel Institute and has contributed Papers to the Institute of Metals and the Faraday Society.

From 1919 to 1930 Capt. Orme commanded the University O.T.C. Contingent. He is a keen rifle shot and has captained the 'Varsity rifle team at Bisley on several occasions, as well as having been selected to shoot for his county and for the Territorial Army in the Inter-Services matches.

The Lancastrian Club.

The Annual Banquet of this club was held on Saturday, September 10, at the Restaurant Capucines, Paris, under the chairmanship of Mr. Montupet. Mr. and Mrs. Russell, of Sheffield, represented the British contingent. This club, it will be remembered, is composed of prominent European foundrymen who crossed to America on the s.s. "Lancastria" in 1926 to participate in the Second International Congress held in Detroit. On the Sunday the members were the guests of Mr. Montupet for a garden party held in the beautiful grounds of his château at Villepreux. The next meeting of the club will be held in Prague in September next year.

Random Shots.

Those of you who have seen the film "A Night Like This" will probably remember the scene in which Mr. Ralph Lynn, aided by his ally, Mr. Tom Walls, executes some effective poker work on the skulls of three Real Bad Men. "Marksman" has been reminded of this incident by the reference in both the editorial and advertisement columns of the daily Press to that simple instrument of offence and defence, the truncheon. The suggestion is that the motorist, for his protection against "banditry," should arm himself with one of these truncheons.

* * *

As seemingly simple a weapon as the truncheon may at first sight appear, and as effectively as it may be wielded by the arms of the law, nevertheless it occurs to "Marksman" that in the hands of the motorist it can only be given its full force if the novice has previously been instructed as to its uses and manipulation. The following notes are designed to aid the beginner in his initial experiences with the truncheon.

* * *

Instructions for Use of Truncheon.

(1) Place truncheon in motor-car in position easily accessible to right hand.

(2) Ensure that truncheon cannot possibly be confused with gear or brake lever. This is important. The time taken in wrenching gear or brake lever from moorings might enable bandit to get his truncheon out first. Also, one cannot change gears or apply brakes with truncheon.

(3) When stopped by suspect, first ask if he is a bandit. Should he reply in the affirmative, grasp truncheon, apply same suddenly and forcibly to head of bandit. Transfer inert body to side of road. Report incident at next police station.

(4) Should suspect reply in the negative, carry out instructions as in (3). This is a safeguard against "bandit's guile."

(5) Clean thoroughly after use.

* * *

By the way, while touching on the topic of blows, "Marksman" would like to reproduce the comment made recently by a Frankfurt court on "a box on the ears." They declare: "A box on the ears has for centuries been a popular mode of chastisement which, given at the right time on the right spot with the right force for the right purpose, is unexcelled in its educative effect, and can be replaced in individual cases neither by gentle admonition nor by draconic punishment." "Marksman" can now understand why the expression is preceded usually by the adjective "good" or "sound"; there is so much "right" about it.

* * *

A middle-aged widow, endowed with much wealth and disagreeable temper, complained to her son-in-law that she was annoyed by the attentions of a certain man.

"How can I get rid of him?" was her question.

"Marry him," suggested the son-in-law.

"I'd see him hanged first."

"Just marry him. It won't be long before he'll hang himself."

Marksman.

A Proposed British Foundry Technical Training College.

By Vincent C. Faulkner (Past-President, Institute of British Foundrymen).

The proposition to be dealt with is the examination of the problem as to whether there is a demand for the creation of a centralised technical training institution in Great Britain specially organised for the tuition of students destined to become the executive officers of the foundry industry. This question has no doubt been posed because of the publicity which has been accorded to the Paris and Aachen foundry technical training colleges. The factors in favour of such a development are:—

(1) The scientific background to modern castings productions is of ever increasing importance; (2) A national advertisement in international markets; (3) The supply of high-grade technicians for staffing local technical colleges; (4) For smaller organisations it would supply a man capable of combining the duties of foundry manager and metallurgist; (5) The creation of a personnel within the industry highly capable of applying the results of scientific research to the benefit of the units composing the industry.

Adverse factors are:—

(1) The possibility of the influence of locality orienting the training to line up with the type of foundry predominating in the district chosen. For instance in Sheffield steel founding might be unduly stressed, or in Falkirk, that of builders' castings, and (2) the whole tradition or goodwill of the school can be spoilt through the occupant of the professional chair being unsuitable or biassed.

Thus it is postulated that the advantages outweigh the disadvantages, and the next question is the choice of a suitable locality in which to house the proposed college.

The following factors must have consideration, and they are set out in order of importance: (1) Tradition, (2) scholastic grade, (3) range of teaching departments, (4) equipment and (5) locality.

Tradition.—In any scholastic institution, the tradition which it has acquired throughout decades or generations bestows upon it a certain cachet in which every student participates throughout life from the moment of graduation. There is no need to recall to mind the names of the older Universities, the Conservatoire of Music at Paris or the Liverpool School of Tropical Medicine and so on. It is suggested that the only two academic institutions in Great Britain that have acquired a tradition recognised mondially as a centre of thought for and development of foundry practice are the Universities of Birmingham and Manchester. The tradition of the former is due to the classical researches of Prof. Emeritus Thomas Turner into the influence of silicon in cast iron, and the latter ascribable to the work of Prof. Sir Henry Carpenter on the growth of cast iron.

Scholastic Grade.—Whilst it is not suggested that a University degree is necessary, it is felt that facilities should be available for an extended course of perhaps a year which would carry either an engineering or a metallurgical degree in science.

Teaching Departments. — As a qualified foundryman must possess both engineering and metallurgical knowledge, the proposed institute would require to have departments devoted to ferrous and non-ferrous metallurgy, mechanical and electrical engineering, fuel technology and geology and mineralogy.

Equipment.—The departments enumerated should be adequately equipped from the foundry view point, but in addition there should be available a foundry equipped with cupola, high frequency and non-ferrous melting furnaces, moulding machines of wide range; sand-preparing and testing machinery; fettling machinery. An essential feature of this department would be that the equipment must be of such a character that it is available for both teaching and research. That research work must be carried out is an essential, in order to prevent the teaching staff suffering from mental ossification through routine work, and also to afford a means of publicity for the proposed institute.

Locality.—The position chosen must be the centre of foundry activities, because the success of the proposed institute would centre very largely around works visits, which would be undertaken one day per week. Founding, being a practical science, must make constant contact with industrial establishments.

Having outlined the fundamental principles, it merely remains to see how the various existing educational establishments fulfil these conditions.

We immediately rule out Falkirk, Newcastle, Glasgow, Middlesbrough, Sheffield, Liverpool, Loughborough, South Wales and London, and other centres, on the score of tradition, leaving only Manchester and Birmingham for consideration. These two cities are both fortunate in the possession of both a University and a technical college. As it has already been postulated that for the sake of status, a University is to be preferred and the choice now rests between the Universities of Birmingham and Manchester. Both possess excellent departments for covering the course of studies requisite to the mental equipment of the high-grade foundry executive, but Birmingham is, perhaps, the better equipped and is probably a more suitable centre for works visits. In a broad sense there is no branch of foundry work not practised in the area covered. Thus, it is established on the premises cited, that a foundry institute could best be established within the walls of the University of Birmingham.

It so happens that this is also the centre where the British Cast Iron Research Association has established itself, and any liaison between this organisation and the proposed Institute could not help but be beneficial to the cast-iron section of the industry.

Not being an expert on educational matters, no attempt has been or will be made to create a time-table for the pursuance of the course of studies advocated. Subjects are enumerated, and it is left to the specialists to say in what year they should be tackled and how much time be devoted to each. Experience gained from long and close contact with the foundry industry has indicated that a foundry executive should have knowledge of many diverse subjects. For their study and application, the minimum standard of education required is that of the London Matriculation.

Metallurgy.—As the foundryman has to deal with an extremely wide range of alloys, he should not be called upon to specialise in any one branch until his third year or perhaps in a post-graduate course. In the first year, however, the student must learn to analyse both the raw materials and finished products of the industry. These will be the materials used in the making of castings in the practical laboratories. Microscopy and microphotography should not be overstressed too early in the course.

Electrical Engineering.—Sufficient knowledge should be gained to enable the graduate to assure himself that his electrical machinery is maintained in the highest order of efficiency; that he will not stand aside in ignorance when his colleagues talk of eddy losses, hysteresis, starting torque and the like.

Mechanical Engineering.—This section of his studies should emphasise mechanical handling, strength of materials, hydrostatics, machine-shop practice, maintenance of plant.

Fuel Technology.—More attention should be paid to the utilisation of fuels than their manufacture. Cognisance must be taken of the fact that foundrymen are called upon to use coal, coke, pulverised fuel, oil, town gas and electricity.

Geology.—Whilst it is confessed that this study is something of a luxury for a practical foundry executive, it should be included, as throwing much light on the constitution of sands, refractories, slags, and even alloys.

Costing.—Obviously, unless castings can be made at a competitive price they are unsaleable. Competitive prices cannot be met with safety unless they are scientifically ascertained. Thus a series of lectures should be devoted to this important subject.

Testing.—This subject is to the average student something of a bore, but by introducing the allied subject of inspection along with it, real interest can be aroused.

Refractories.—This subject must also be included, and the courses available at most technical schools needs but little change to bring it up to date. It should be remembered that several new developments in foundry hinge on the adequacy of the refractories.

Practical Foundry Practice.—It is a *sine qua non* that foundry practice can only be learnt on the floor of a jobbing foundry, but much can be done by utilising moulding machines. Here ramming densities can be controlled with a minimum of effort. Series of moulds carrying variations can be made. Knowledge can be gained by students trying to mount all types of castings on plates. Experiments can be made with various sizes of runners and risers, whilst the mould can be cast with varying amounts of vents. In any case, a standard of proficiency amongst the students should be sought which would enable them to produce good castings at will repeatedly from a range of patterns of increasing complication.

Patternmaking. — Sufficient time should be spent in patternmaking to enable the student to grasp the fundamentals and acquire sufficient proficiency to enable him in later years to exercise an intelligent control over that department.

Other Sections.—Such subjects as vocational suitability, industrial psychology, Patents Law, French and German foundry technological phrases and motion studies are just a few subjects worthy of an odd lecture or so. This brings the subject to the question of staffing.

Institute's Personnel.

The institute would be controlled by its own professor, aided by lecturers in metallurgy and engineering, and high-grade demonstrators in patternmaking, machine moulding and machining. In addition, however, recourse should be had to the professors and staff of other departments for tuition in geology and fuel technology, physics, chemistry and the like. But a radical departure should be made from the normal university curriculum by inviting prominent specialists to give one or short courses of lectures on such subjects as Patent Law, centrifugal castings, industrial psychology, blast-furnace and coke-oven practice and technical inspection. This feature would tend to blend theory with practice.

Ideals.

Perhaps this section should have formed the introduction to the notes, as it is explanatory of the whole scheme. Primarily it should be the concrete answer to the oft-imposed question, Which is the best institute for acquiring a knowledge of foundry practice in Great Britain? The institute would achieve this unassailable position, by the systematic development of the

powers of observation amongst the students, and by the gradual disclosure of the whole field of foundry practice. One method would be to cause students after a works visit to reproduce the lay-out, point out its advantages and show where improvement could be effected. To describe and criticise the moulding methods used. To discuss the reasons for their personal failure to produce sound castings from various patterns. If, when they have finished their studies they realise what they have to learn when they receive an industrial appointment, much will have been achieved.

Factors Essential for the Success of the Scheme.

The success of the kindred establishments abroad is due primarily to the very considerable support accorded to them by the foundry employers' federations. From personal contact, it can be stated that the principal officers of both the Syndicat des Fondeurs and the Verein Deutsche Eisengiesserei Verband take a great personal interest in the schools their associations so largely support. Not only do they take the graduates into their employ; but they give personal service by lecturing to the students, throwing open their works for inspection and for use in connection with vacation courses. In addition to works visits and vacation courses, study tours must form part of the regular curriculum. These tours would be undertaken, say, before the opening of the autumn session and the students would be accompanied by a member or members of the teaching staff, even if this involved a sacrifice of a part of his vacation.

It is essential that a certain amount of research be carried out in the proposed institute, because on the worth and value of this work largely depends its goodwill in the eyes of the world, and federations and large firms should be induced to finance this post-graduate work.

Apart from any help accorded by employers, both privately and co-operatively, this nebulous institute should be supported by both the Institute of British Foundrymen and the British Cast Iron Research Association.

Necessary Measures.

Before such a scheme could be launched, it would be necessary to build up an adequate guarantee fund. This established, it would be necessary to approach the educational authorities with a carefully-prepared programme, showing the amounts it was prepared to spend on housing and equipment, and the capital sum available for endowing a chair of foundry technology and the provision of salaries for the teaching staff. Even before these steps could be taken it would be necessary for some body to interest the employers, because the raising of £100,000 is not an easy matter under the prevailing industrial conditions. Yet a donation of £20 per foundry would ensure the successful financing of the scheme.

A New Steel Flooring.—From the Mellon Institute of Industrial Research at Pittsburgh comes an announcement describing a new type of steel flooring called the "Robertson Keystone-Beam Steel Floor." This flooring consists of slabs, 24 in. wide and up to 12 ft. 5 in. in length at present, that are fabricated by preforming two steel sheets and subsequently welding them together in the plane above the neutral axis. A cross-section taken through the width of a completed unit shows four keystone-shaped cells, all connected together near the neutral axis. These four ducts, which constitute each unit, are spaced at 6-in. intervals and connect directly, when installed, with the corresponding ducts of the adjacent section of floor slab. This arrangement is described as enabling the utilisation of the new floor not only as an efficient load-carrying member, but also as a multiple floor-duct system for handling all types of electrical lines. The keystone slab can be installed with ease and rapidity. It can be bolted, clipped, or welded into place across the structural members, affording a working floor for the various trades.

American Society for Testing Materials.

AMERICAN TENTATIVE SPECIFICATIONS FOR MALLEABLE IRON CASTINGS.

A.S.T.M. Designation: A 47 — — T.

This is a Tentative Standard, published for the purpose of eliciting criticism and suggestions, and as such is subject to annual revision. (Issued 1932.)

1. *Scope.*—These specifications cover malleable-iron castings for railway, motor vehicle, agricultural implement and general machinery purposes.

Manufacture.

2. *Process.*—The castings shall be produced by either the air-furnace, open-hearth or electric-furnace process.

3. *Primary Graphite.*—Castings shall be free from primary graphite.

Physical Properties and Tests.

4. *Tensile Tests.*—(*a*) The tensile-test specimen specified in Section 6 shall conform to the following minimum requirements as to tensile properties:—

	Grade No. 32510.	Grade No 35018.
Tensile strength, tons per sq. in.	22.3	23.6
Yield point, tons per sq. in. ...	14.5	15.6
Elongation in 2 in., per cent. ...	10.0	18.0

(*b*) The yield point, defined as that load under which the specimen has an elongation in 2 in. of 0.01 in., may be determined by the drop of the beam of the testing machine or by the divider method.

5. *Special Tests.*—(*a*) All castings, if of sufficient size, shall have cast thereon test lugs of a size proportional to the thickness of the casting, but not exceeding $\frac{5}{8}$ by $\frac{3}{4}$ in. in cross-section. On castings which are 24 in. or over in length, a test lug shall be cast near each end. These test lugs shall be attached to the casting at such a point that they will not interfere with the assembling of the castings, and may be broken off by the inspector.

(*b*) If the purchaser or his representative so desires, a casting may be tested to destruction. Such a casting shall show good, tough malleable iron.

6. *Tensile-Test Specimens.*—(*a*) Tensile-test specimens shall be of the form and dimensions shown in Fig. 1.* Specimens whose mean diameter at the smallest section is less than $\frac{12}{32}$ in. will not be accepted for test.

(*b*) A set of three tensile-test specimens shall be cast from each melt, without chills, using heavy risers of sufficient height to secure sound bars. The specimens shall be suitably marked for identification with the melt. Each set of specimens so cast shall be placed in some one oven containing castings to be annealed.

7. *Number of Tests.*—(*a*) After annealing, three tensile-test specimens shall be selected by the inspector as representing the castings in the oven from which these specimens are taken.

(*b*) If the first specimen conforms to the specified requirements, or if in the event of failure of the first specimen the second and third specimens conform to the requirements, the castings in that oven shall be accepted, except that any casting may be rejected if its test lug shows that it has not been properly annealed. If either the second or third specimen fails to conform to the requirements, the entire contents of that oven shall be rejected.

(*c*) *Retests.*—In case one of the retest specimens contains a flaw which results in the failure of the specimen to meet the specifications, at the discretion of the inspector additional test specimens from the same oven may be tested, or test specimens cut from castings may be tested.

8. *Re-annealing.*—Any castings rejected for insufficient annealing may be re-annealed once. The re-annealed castings shall be inspected and if the remaining test lugs, or castings broken as specimens, show the castings to be thoroughly annealed, they shall be accepted; if not, they shall be finally rejected.

9. *Workmanship and Finish.*—The castings shall conform substantially to the patterns or drawings furnished by the purchaser, and also to gauges which may be specified in individual cases. The castings shall be made in a workmanlike manner. A variation of $\frac{1}{8}$ in. per ft. will be permitted.

10. The castings shall be free from injurious defects.

11. *Marking.*—The manufacturer's identification mark and the pattern numbers assigned by the purchaser shall be cast on all castings of sufficient size, in such positions that they will not interfere with the service of the castings.

12. *Inspection and Rejection.*—(*a*) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the castings ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the castings are being furnished in accordance with those specifications. All tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

(*b*). The manufacturer shall be required to keep a record of each melt from which castings are produced, showing tensile strength and elongation of test specimens cast from such melts. These records shall be available and shown to the inspector whenever required.

13. Castings which show injurious defects subsequent to their acceptance at the manufacturer's works may be rejected, and, if rejected, shall be replaced by the manufacturer without charge to the purchaser.

* Not reproduced as it is a simple test-piece 2½ in. between shoulders, turned from a ¾-in. dia. bar.

Egypt's New Dam.

Ibrahim Fahmy Pacha, the Egyptian Minister for Public Works, is visiting this country in connection with the Gebel el Aulia dam, to be constructed thirty miles south of Khartoum. He has been in communication with the consultant engineers of the dam and has visited engineering works at Southampton and Ipswich. All details have now been settled, and the plans and specifications for the new work will be completed by November 15, when tenders will be invited.

Messrs. Marshall, Sons & Company, Limited, of Gainsborough, announce the purchase for sinking fund of 5½ per cent. (free of income tax) first mortgage redeemable debentures to the amount of £20,750 nominal value in respect of the year ending December 31, 1932.

Messrs. Turner & Newall, Limited, announce that those of its subsidiary companies—nine in number—which deal exclusively with the sale and application of insulating materials have been consolidated into one organisation since October 1. The new company will trade as Newalls Insulation Company, branch of Turner & Newall, Limited. The subsidiary companies which will be consolidated are:—Thomas Anderson, Limited; Carbon Cement Company; Hobdell, Way & Company; Newalls Insulation Company; Newalls Insulation Export Company; Reid McFarlane & Company; Reid McFarlane & Company (Belfast), Limited; Reid McFarlane (London), Limited; Sutcliffe Bros. & Bryce, Limited. The new branch company will, it is stated, be by far the largest concern in the insulation trade in Europe.

A Conservative Industry.

A STUDY OF FOUNDRY ECONOMICS.

The London Branch of the Institute of British Foundrymen held the first meeting of its 1932-33 session on September 15, 1932, at the Charing Cross Hotel, W.C.2, when Mr. H. G. Sommerfield (the Branch-President) delivered his presidential address.

Arrangements have been made for the whole of the Branch meetings during the coming session to be held at the Charing Cross Hotel. Apart from the fact that this venue is central, it has the added advantage that the discussions can be extended beyond 10 o'clock, if desired, instead of having to be closed down promptly at that hour, as was the case last session, owing to the necessity for closing the hall in which the meetings were then held. On more than one occasion interesting discussions have had to be curtailed for this reason.

Minutes.

The minutes of the preceding meeting of the Branch, held on March 17, 1932, were read, confirmed and signed.

Presidential Address.

Mr. Wesley Lambert, C.B.E. (Past-President of the Institute), occupied the chair. Introducing Mr. Sommerfield, the chairman commented upon his great work for the Branch in the past (particularly in his capacity as hon. secretary for a number of years), and his enthusiasm for the work, and added that he was a Branch-President of whom the members would be proud. The chairman expressed his personal delight that Mr. Sommerfield had accepted the office, because he was an enthusiast; he had made himself known to all the members, and would encourage them to take an active part in the proceedings. One of the things of which the Branch stood in need was that more of its members should take part in its discussions and give others the benefit of their experience.

Mr. Sommerfield then delivered his presidential address, in the course of which he said:

Mr. Lambert and gentlemen,

The inspiration for this address arises from the report of a speech by Mr. E. J. Fox, who, whilst presiding just recently at a company meeting, observed:—"The greater proportion of foundry equipment required by home industries had hitherto been imported from abroad. These importations had been dictated, not on account of price, but almost wholly due to the fact that anyone requiring to modernise or lay out a new foundry had found the technical guidance and knowledge available abroad to a far greater extent than in this country."

No one would question the competency of Mr. Fox to make such a statement as this. His knowledge and experience of the industry always command consideration. One is, nevertheless, entitled to ask one or two pertinent questions—firstly, is it an indictment of British foundries and plant manufacturers—and secondly, does it imply inability to grasp opportunities.

One is supposed not to be controversial in a presidential address, but rather to chromium plate old platitudes and cement the blow-holes of impossibility in practice. Nevertheless, it is proposed to risk whatever departure from the orthodox one may incur and to analyse Mr. Fox's statement. If Mr. Fox is reported correctly, the indictment of the industry is that technical guidance and knowledge is found abroad to a greater extent than here in Britain. Why is this? Industry has always produced men possessing a scientific mental attitude relative to every problem, and surely it would never be conceded that any one country had a monopoly. Can it be that abroad, for argument's sake, a young man has facilities for investigation, research and experiment on unfettered lines of his choice, whilst here at home his contemporary is forced to plod along conventional lines and within limits imposed by a superior—probably disinterested and inefficient—owing to absence of modern scientific training. This might account for that lack of initiative, progress and development, that is implied in the remarks in question, and which would eventually seriously handicap the best production under scientific management.

Is Experience Everything?

Do the older men in British industries to-day believe almost entirely that experience is everything? Do they deplore the direct application of science? Is this a fault in our national industries, including foundry work? Can any relationship be traced between this and Mr. Fox's indictment? A series of questionings may elicit more than straightforward talking. Thus, the next question is, are the British as a nation more inclined to industrial practice which, after all, is based on experience rather than towards the scientific pursuit which is obviously a close and methodical study of experience in the light of science? To my mind more scientific inquiry into what experience has taught would be good for industry. Have the British been more eager to manufacture and supply plant and machinery which they thought would appeal to managements and operatives rather than to produce and market installations proved of value after exhaustive scientific inquiry into the records of experience and probably without over-regard to those in the industry concerned? Do they keep the tests and results of the laboratory in the laboratory itself as close-guarded secrets and remain apprehensive about transferring or applying them direct to works and to production for profit? Does the chemist here in Britain exist too much in a watertight compartment and remain to some extent unapproachable, happy in his own knowledge, supreme, as it were, in his own kingdom—the laboratory—and be disinclined to assist the man who runs the foundry or works? Chemists who are managers or who are definitely in charge of works have personally been found to be more human and helpful than those whose only realm is the laboratory, which is oft-times approached by the foreman in awe and with the subconscious feeling that he will not be helped very much in his quest for information or in his dilemma of a moulding or casting problem.

Science and Practice.

The scientific mind does not always come readily to aid experience and practice. Can this in a small measure be in any way responsible for the assertion made by Mr. Fox? Can one judge the better works to-day in the light of these observations? Reference is, of course, being made to those works sufficiently large as to include extensive laboratory practice. Is there something outstanding in the factory where really scientifically-minded men as trained heads of departments experiment, and apply the knowledge thus gained to control every process of production, or can one say with certainty that the foreman's experience, when left unaided in his choice of material and method of manufacture, ensures unquestionable progress and prosperity for a firm. If one reflects upon the motto of our Institute, one might say that neither would be a really successful works. It is only where science does go hand in hand with labour that the best can possibly be achieved. The happy combination of the scientifically-trained mind with the practical mind is still greatly to be desired in British works.

Dual Form of Control.

A plea is made to abolish dual foundry control. Often one finds that the manager or foreman is nominally in control, but the chemist is responsible for the choice of his raw materials, mixtures and even probably cupola practice. Can this conduce to the best results? It is admitted that smaller works cannot afford the scientific minds who give such admirable service to larger concerns, and it is probably here that a line of demarcation can be made. Managements should unhesitatingly appoint one man alone as manager of a foundry. That person can have as his first assistant a thoroughly experienced practical foundryman or the head of a laboratory.

Until scientific control is generally appreciated—and it should come rapidly as a result of modern-day training—a gulf *will* exist between the laboratory, the foundry, and the rest of the works. A great many foundry managers to-day are highly-trained metallurgists, and they combine with that science, a very sound practical experience. In those works, however, where just a small laboratory can be maintained with a single chemist to run it, there should undoubtedly be a foundryman as manager, and the chemist should work with him and not, as is sometimes the case, be able to treat him with indifference because he has direct access to the management or directors. This is service obviously to the detriment of production. There are as equally high-paid practical men as managers as there are metallurgist-managers, and this should soften the blow to any of either type of manager who may fondly imagine that he alone is supreme.

Now, what is this to do with the observation that technical guidance and knowledge is to a far greater extent available abroad than in this country? It indicates, rightly or wrongly, that here in England the staff works too indiscriminately, too independently, and without that extraordinary close co-operation, concentration and pooling of results that may characterise foreign works.

Departmental Responsibility.

One scientifically-trained mind co-operating with a pair of hands endowed with experience of practice can do more with a team of departmental controllers than an administrator endeavouring to concentrate entire management on himself, and who must thereby of necessity be often at the mercy of subordinates a little more knowledgeable on some points than himself. Get the right man into departmental responsibility and give a little more departmental control under the right directing mind just referred to. See that an hour is given in conference at least weekly to these departmental heads or foremen, not for the purpose of saying everything is wrong, but for them in turn to create amongst their subordinates the enthusiasm exhibited by the administrative heads for the benefit of economical production. The men in charge of the foundry, the machine shop, the sand-blasting department and the enamelling or plating shop should always be on the most amiable terms, and this can the better be fostered by that weekly or even more frequent meeting, than by leaving each to work on unconcernedly at apparent, and sometimes only too apparent, high pressure which contributes often to the passing of irritating messages and consequent difficulties of production. A personal experience of some 20 years of foundries and engineering works at home and abroad has brought about the conviction that, if managements generally recognised the importance of more departmental control with that closer co-operation between all heads, production would be speeded up advantageously. Say there are three or four foremen running as many different departments, all of which, however, are more or less inter-dependent. These men probably only meet casually; they never have that regular hour conference in a private room

away from the noise of the works, and in consequence there frequently arise instances when the machine-shop man complains of hard spots, more costly tooling, less output, etc., and a really nasty message is forthwith sent to the foundry. This irritates, and some slanging ensues, all on account of the busy and noisy environment. The suggested periodic conference would undoubtedly do more than anything else to avoid all this. A further suggestion made is that the buyer should also attend these informal conferences, so that he can get a better knowledge of requirements and understand more of actual working conditions. This represents just one of the small ways of pooling technical knowledge, the lack of which in this country Mr. Fox deplores. It can be called a study of work, and should prove a step towards removing that indictment of the industry which is claiming worldwide attention.

Opportunity!

The second query on Mr. Fox's remarks was:—Did it imply inability to grasp opportunity? The question of scientific control has been dealt with, but it must be borne in mind that a works of modest proportions can be responsible for the production of exceptionally superior material or plant equally as well as a concern producing on a vastly larger scale. The latter might have distinct advantages in respect of its own self-contained research departments. Nevertheless it can hardly be admitted that works generally have failed to grasp opportunities even in the fundamental directions of research.

After the war there was created a nucleous of co-operative research under government subsidy, known as the Department of Industrial and Scientific Research and it is eloquent of the Britisher's eagerness to grasp opportunities that all descriptions of firms willingly agreed a levy supplemented £ for £ by the Government so that the results of investigations into industrial and scientific problems could be at the disposal of all. Industry grasped this opportunity and is still paying its premium to-day despite the acute depression which grips it. It is probable, however, that some specialised forms of mechanical production have profited more than others as a result of intensive and exhaustive research. The motor-car industry seems to thrive on its research and to grasp every opportunity. Can the same be said of the metallurgical industries, especially the foundry section. In this connection it is felt that much research remains a prisoner behind fast closed laboratory doors. If this is so, industry must lose the major benefits. Are chemists often a little uncertain of their findings unless substantiated by practice? Does the chemist and metallurgist confine himself too much to the laboratory and rely too often on the results of practice of others? If after meticulous research he undertook far more large-scale work to gain the experience thereof, would it not be better for industry and would he then come more boldly out and state his case in unequivocable terms? Would not this give more opportunity for industry to grasp?

Confirmation by Practice.

Generally speaking, insufficient experiments are carried out on the foundry floor. Tests in a laboratory may be perfect in their conception and small-scale application, but time and money can be wasted and opportunities lost by leaving it at that and asking a practical man to interpret the science of the chemist under conditions singularly different from the laboratory. Industry, to grasp every opportunity, should tell the man of science practically to demonstrate and prove his contentions and produce under actual working conditions. By this means an eliminating process might operate systematically by cutting out unnecessary operations and adopting modifications as suggested by practice to ensure absence of wasteful labour and so arrive at economical and competitive production. Do our industries exist too much in a stalemate condition by not grasping opportunities of modernising their plant? Is their production a struggle rather than natural evolution? It was during the last International Convention that at a works visit in the Midlands some of our American friends were amazed at plant about a hundred years old and still operating. This may be laudable in an antique sense, but can such installations possibly compete with modern developments of engineering? Printers to-day, in their competitive production in which speed and accuracy are all-important, are constantly being assisted with most wonderful machinery, but when it comes to the foundry the same cannot be said. To grasp every opportunity in industry, it seems more and more imperative to organise and control scientifically, always having in mind that production must fit the job and earn its costs. It may be said that this is platitudinous and that theory will upset practice, yet if this technical guidance and knowledge which Mr. Fox says is to be found abroad to a greater extent than in this country, then we must admit in industry to be taught by science.

The industrialist's object is to produce goods of marketable value at a profit to himself—the scientist conducts every conceivable research irrespective of cost with a view to his experiments eventually producing by a given process a desired result. It is here that the administrative heads can get down to basic facts and co-ordinate all available data and statistics with a view to developing process of manufacture and ultimate output. After having given a few thoughts upon scientific control of industry as well as the practical, it will be obvious that it still remains for the administrative men to do their part in helping to place British manufactures on a par with the foreigner's—assuming that Mr. Fox is correct in his statement. The man who has devoted long years to science and the man of exceptional practical experience may deplore the fact that so seldom is an administrative post available to him. Science and practical experience are not alone the sole qualifications for high administration. Scientific education during school days and onwards is becoming more and more general as distinct from commercial or other training, and the young man to-day whose ambition is to reach the top of the tree in an executive sense must not plod along for ever in the laboratory or in the works.

Administration.

Administrative posts in industry are open to anyone competent. Competency comes through exact knowledge or science, experience or practice and the human-knowledge factor or sound common sense, coupled with an ability to grasp opportunities and co-ordinate the sum total of one's training and experience with the sole view of organising and producing on a better basis than the man next door. This personal conception of administrative qualification is given because it shows that neither science nor experience alone nor together are sufficient. The scientific head of a works will be concerned with actual findings, rely probably too much upon statistics and forget that economic problems may demand sound independent judgment and courageous action. The practical head will believe only in what he daily sees as a result of his work based upon his long experience. The administrative head undoubtedly has to go much further, and often he must discard for a while accepted theories, discount what statistics may imply and cleave a very distinct and independent line of action dictated by his common sense and judgment. Two comparable works may be producing similar articles at a variation of cost. It need not be necessarily concluded that one works is more efficiently managed than the other, but it should, when known, very much concern the administrative heads so that attention can be directed to discovering *why* the costs vary. This is purely a job for the business man, and when he gets down to it improvement will result.

Probably, if Mr. Fox's assumption be correct, there is more room for administrative heads to grasp opportunities in Britain than there is for scientific and practical men. One hears over and over again that it is the directors who will not grant so and so, although it can be conclusively proved that more competitive production can result and the capital charge of the new plant recovered within a definite period. What is the real reason for this? Has Mr. Fox brought vividly home to us the consequences? Is it true that so many dislike the sound of something new; in fact, they turn off at a tangent and say there is nothing in it, instead of giving it constructive consideration. Is the British mind unable to grasp what others have discerned; are too many afraid to invest in a more or less certainty in order to accumulate? Do too many administratives live placidly on introspection and deny themselves the success that prompt well-planned action might ensure? If administratives could only measure the results a probable reorganisation and modernisation of their works could show, in comparison with the results they know they have at present, it is certain much new plant would be installed in the foundries in this country—to the immense advantage of industry generally.

Business to-day still flogs the cry, "Payment by Results," and yet how many directors with foundries forming a part of their works render any material assistance towards the achievement of those results they say they are so anxious to pay for. It is said that it is impossible to afford the expenditure of even £100 in the foundry and yet probably many many times that sum is spent annually by them for the unproductive labour of men who are constantly engaged in fetching and handling goods and materials. This must be a drain and would be apparent in the firms costing system if accurately measured. An equivalent expenditure on some form of conveyor system, whereby the work was brought to the operative in such a way that he could comfortably handle it, would undoubtedly turn loss into profit, estimating the same number of men being actually employed. We may be told that business does not warrant it—there is not the demand for the output. Will there ever be a demand for that production whose costing systems shows it is not competitive with another? Managements spend colossal sums a year on town's gas—and it is doubtful if such an item is always correctly apportioned in a costing system. Modest expenditure on modern equipment would convert this undoubted waste into infinitely more profitable commodity. There are so many contingent factors governing output that only live administrative heads can see into. It is common in machine shops to see a tall man having to stoop unnecessarily over a low bench or machine and again a very short man struggling to manipulate a machine tool almost out of his reach. Equip a man comfortably for his job and if a hazardous one insist upon him being suitably protected from a safety-first point of view. Such adjustments must conduce to a more efficient and smooth-running production on an economic basis. Do directors look into the details of foundry work; have they the interest in them; are they as conversant with such matters as they should be, to guarantee to their board that every opportunity has been grasped? Many such men may content themselves with reading the technical Press and exchanging views with other business men—but they should go much further. In addition to compiling an elaborate costing system and statistics of their own productions and consumption together with any available from a competitive source, why not endeavour to measure everything that may have an influence on the demand for every article they manufacture or would like to produce. This would take them a step further and lead to better business. Too often it is thought works exist solely to produce, whereas the sole object of production is consumption—to supply a

demand for goods that the world requires. Productive system to-day can readily supply in ample quantities all that everyone requires and still have a surplus. There is no difficulty in producing, hence something must be acting as a break upon the consumption which governs production, obviously of a financial character.

One paper will relate that world prosperity will never return until there is a rise in prices generally, whilst another will assert that to secure this return to prosperity men must work harder, produce more, consume less and work for less money. Financial stringency—this wave of economy—cannot help industry, so how can it help the country, though it is readily admitted it is necessary in these directions. Chairmen of large concerns can materially help to check the serious deficiency of the public purchasing power. In a recent article it was stated that an engineer, Major C. H. Douglas, by examining from first principles onwards and following process logically, step by step, had located a fundamental error in costings, an error it was alleged responsible for the prevailing appalling conditions. Over a given period the cost of the whole production of a community is nothing more than the consumption of that community. This might well be considered a revolutionary idea violating all accepted conventions, yet it is worth consideration in the calculations of industry. It seems to imply that if production is properly and skilfully looked after, consumption can safely be left to look after itself. The advent of machinery in the world, despite to some extent its displacement of labour, actually increased the wealth of industrial countries. Men taken off the production of commodities were absorbed in the production of machines and the building of new works. Why has this progress been arrested in its development? An answer can probably be found in estimating exactly what is actual prime cost in production in comparison with consumption. This is all a matter into which administrative heads should look. Quite recently in The Foundry Trade Journal we read a leading article under the title "A Pat on the Back." Reading this gave me a good deal of reassurance after considering Mr. Fox's observations.

The concluding paragraph of the article stated "The British foundry industry is setting an example to the whole world in the way it is tackling its melting problems." It is to be hoped in the very near future the Journal will also be able to report that the British foundry industry is setting an example to the whole world in the directions of administration, control and production—so that the consumption of the markets of the world can be catered for on such a basis as to stimulate more and more output. A week or two later another leader in the Journal, commenting upon observations made on the article just referred to, regretted that the application "Conservative" had been fixed to the British foundry industry. It went on in an endeavour to dispel this insinuation and mentioned areas in which foundries had been completely mechanised. The pity is, however, that its succeeding statement was to the effect that partial mechanisation is to be encountered on every hand, whilst those possessing just high-grade well-equipped foundries are only awaiting an increment of business commensurate with a serious capital lay-out. The question naturally comes to one's mind—will the mechanised foundries so produce from a stimulated demand standpoint that they will stifle the others attempting on a handicapped basis to produce what a limited consumption might normally demand of them.

It is thought that, although advocating modernisation and mechanisation where necessary, prosperity depends upon the human factors which have been already enunciated under the headings of administration, scientific management and the practical work which embodies the whole process of production. Mr. Fox may be perfectly correct in the matter of his reported remarks. Many may entirely disagree with him, but it has been the object of this address to analyse even the very atmosphere that surrounded Mr. Fox's thoughts, so that, getting down to fundamentals, one can see what is wrong with industry—if wrong, conservative, or behind the times at all—and what means can be employed to establish us as leaders of technical guidance and knowledge which it has been said is at present available abroad to a greater extent than in this country. This seems a very suitable occasion for sending sincere greetings from this first seasonal meeting in London to overseas members and to express the hope that the Institute may always be a source of interest and help to them.

Heat-Treated Alloy Cast Iron.

Whilst British foundries are making considerable headway in the production of heat-treated alloy cast iron, other countries are also seriously entering this field. For instance, Mr. Edwin F. Cone, in a recent issue of "The Iron Age," describes how the Bullard Company, of Bridgeport, Conn., are using a nickel-chrome cast iron for machine-tool parts.

In the Mult-Au-Matic machines, obtainable in six- or eight-spindle models, which perform several machining operations respectively at five or seven stations at one time, massive construction with its accompanying absorption of vibration has been deemed essential to best results. This massive and rigid construction permits the use of greater input power, increased speeds and heavier feeds than heretofore required by the average user, but which have become almost essential to production efficiency with the use of the newer cemented carbides and other cutting materials.

Alloy Steels Used.

To keep pace with these developments, there has been a wider and wider use of alloy steels and irons in machine-tool construction. In the new Bullard type "D" Mult-Au-Matics, a large number of parts, including clutches, pinions and gears, are made of an alloy carburising steel (3.40 to 3.80 per cent. nickel and 1.25 to 1.75 per cent. chrome). Many parts also are made from an oil-quenching type of chrome-nickel alloy steel. These steels are carefully heat-treated to meet safely the needs of the various parts.

In certain cases, however, the characteristic function of parts, such as slides, saddles, saddle guides, tool slides, slide gibs and swivels, do not require the strength of high-grade steels but, on the other hand, must have sufficient strength and wearing quantities to meet the demands of their particular function.

A Nickel-Chromium Cast Iron Developed.

A progressive step in metallurgy to meet these conditions is the development by the Bullard Company of a new alloy cast iron incorporated in the parts listed above. This is not a "hit-or-miss" development, for this iron is being produced commercially and is giving exceptionally satisfactory results where ordinary cast iron has fallen short. It is a nickel-chromium iron and, when needed, may be suitably heat-treated to meet conditions and requirements. It is a type of what has come to be known as high-test iron, and yet in its treatment will develop some remarkable physical properties.

In making up a heat, as a basis for the cupola charge, about 94 per cent. average steel scrap is used. Then, about 2.50 per cent. of 90 per cent. ferro-silicon and 2 per cent. of 90 per cent. ferro-manganese are added. This material is coated with cement before being introduced into the charge. Ladle additions consist of 1.50 per cent. of "F" nickel shot and 0.50 per cent. of ferro-chromium. A typical composition of the resulting iron is as follows:—Gr, 2.25; C.C., 0.50; Si, 2.41; Mn, 0.85; S, 0.097; P, 0.031; Ni, 1.80, and Cr, 0.42 per cent.

There is a marked difference in physical properties of this alloy iron as cast and after heat-treatment. As cast, this iron has a tensile strength of 22.3 to 24.5 tons per sq. in., with a transverse strength of 5,000 to 5,500 lbs. per sq. in. The Brinell hardness of the cast metal is 212 to 240.

Special Heat-Treatment gives High Strength.

In order to raise the tensile strength and hardness of this material for certain requirements, it is subjected to heat-treatment; the following practice being typical: The castings are heated to 842 to 871 deg. C. and then quenched. Tempering is then done at 455 to 510 deg. C. to give a Brinell hardness of 286 to 340. Selection of the quenching medium is governed by the size of the section being heat-treated; heavy sections are quenched in water, while lighter ones are usually quenched in oil.

The average tensile strength of the heat-treated iron is 31.2 to 33.4 tons per sq. in., according to the company's tests.

Catalogues Received.

Continuous Core Drying.—The Foundry & Engineering Company (West Bromwich), Limited, Sandwell Road, West Bromwich, have found it necessary to supplement their catalogue by a new four-page illustrated leaflet, as since the publication of the former they have made a number of installations of their vertical continuous stoves for core drying. For instance, Morris Motors, Limited, at Coventry, now have five working and on order. The output of an 18-ft. 6-in. long stove is stated to be of the order of 30 tons of cores per working day at a fuel and power cost of seven shillings. We learn with interest that a smaller type of plant is being designed in order to extend its field of application to the smaller grey-iron and malleable foundries engaged on repetition work.

Air-Blowing Fans.—Messrs. James Keith & Blackman Company, Limited, 27, Farringdon Avenue, London, E.C.4, in catalogue V69, describe and illustrate a particularly wide range of fans for use with oil- and gas-fired furnaces. Its appearance is particularly appropriate at the moment when the foundry industry is paying such close attention to alternative types of furnaces for melting metals. A very true statement appears in the introductory paragraph, which reads that fans should "for efficient combustion possess a characteristic ensuring a steady pressure entirely free from pulsation or surging." Only recently we inspected an oil-fired furnace which suffered badly from this defect and caused heavy metallic losses. The range now made covers 17 powers actually from ½ to 40 h.p. With this catalogue we also received three revised editions of catalogues K25, G105 and G133, which cover the subjects of paddle-wheel fans, industrial heating by the Keith gas systems, and the Keith thermostat gas controller. All the booklets are uniform in style, and judging from their pagination form part of a general catalogue published by this house. The study of G105 is worth while by those who are interested in die casting and machine moulding.

Shower Baths.—A four-page leaflet has been received from Messrs. Gummers, Limited, of Rotherham. This pamphlet illustrates and describes a new and very economical type of shower bath. Instead of the usual perforated rose, the "Minispray" has but a tiny hole, so designed that the water is delivered in fine spray. For foundries possessing bathing accommodation for the operatives, the installation of Minispray showers should be accompanied by economics both in the use of water and fuel for its heating.

Scale Removal by Acid Pickling.*

By A. B. Winterbottom and J. P. Reed.

(Slightly abridged.)

Wherever close sizes and good finish are demanded in bars, sheets, wire, tubes and sections, cold-working, that is, cold-rolling or cold-drawing, is a necessity. This, in the case of ferrous materials, with present-day methods of working and annealing, generally involves the removal of mill or annealing scale prior to the cold-working operations. Such de-scaling is almost invariably accomplished by pickling, so that pickling can be said to be an essential stage in the production of cold-finished steel products. This stage influences the economics of the whole production process, both by its direct costs and also indirectly by the limitations on the speed and flexibility of production that it imposes. For these reasons it is necessary to know what are the important factors technically and economically in order to organise for the optimum conditions of production.

Although this will readily be acknowledged, and although much practical and academic work has been done on the subject, an investigation of both aspects of pickling together seems to be lacking. The following is an attempt to meet this need, and it comprises a record of both laboratory and works investigations.

The general scheme of the work is as follows:—(1) Examination of the condition of the material to be pickled; (2) investigation of the physical chemistry of the pickling process; (3) discussion of the applications of the results of the foregoing with a view to obtaining the best commercial efficiency; and (4) notes on simple control methods.

Initial Condition of Material to be Pickled.

Heated iron is known to acquire a scale coating comprising layers of oxides with decreasing oxygen contents from the exposed surface down to the layer immediately in contact with the iron. The exact nature of the layers and the extent of their development is dependent on the furnace atmosphere and the time and temperature of exposure. It had been previously noted that a scale coating formed after one day at 900 deg. C. consisted of three layers: An outer ferric-oxide layer forming about 2 per cent. of the total thickness, an intermediate layer of magnetite comprising about 18 per cent. of the total thickness, and an inner layer of ferrous-oxide phase amounting to approximately 80 per cent. of the thickness. The overall thickness of the scale was of the order of 0.4 mm.

In ordinary works practice the amounts and dispositions of the scale layers are frequently complicated by the cracking of the scale during its formation and consequent diffusion of oxygen inwards and outwards from the crack. Such cracking almost invariably occurs in the fragile layer of ferrous phase following thermal or mechanical stressing. From the equilibrium diagrams which have been put forward for the iron-oxygen system it is possible to infer the probable constitution of scale layers formed under various conditions (Fig. 1). Thus, scale formed at temperatures below 575 deg. C., the temperature of the Fe-Fe_3O_4 eutectoid separation, can only consist of the two oxygen-rich phases, magnetite and ferric oxide, whilst at higher temperatures the ferrous-oxide phase layer must appear, and form an increasing proportion of the total thickness the higher the temperature of scaling.

It has been shown that a diffusion-controlled process, such as the formation of scale, is a parabolic function of the time of scaling, whilst the constant of the parabola which determines its steepness is itself an exponential function of the reciprocal of the absolute temperature, that is:—

$$W^2 = kt$$

$$\frac{d \log k}{dT} = \frac{Q}{RT^2}$$

$$\log k = -\frac{Q}{RT} + \log A$$

where W = weight of oxygen absorbed in time t,
k = constant for any particular temperature, and
Q and A = fundamental constants for a particular material.

In addition to complicating the disposition and proportions of the scale layers, cracking during formation also causes the growth in thickness to depart from the parabolic law. The thickness/time graph in such circumstances may consist of a series of parabolic segments approximating more nearly to a straight line. It is to be expected that a deficiency of oxygen in the atmosphere producing the scaling would result first in a reduction in the rate of scaling and progressively in the suppression of the outer oxygen-rich layers, until eventually non-scaling conditions were reached. Table I classifies the ranges of thickness of the various scale constituents corresponding to the stated conditions of scaling.

Table I.—*Thickness and Constitution of Various Scales.*

Temp. of scaling. Deg. C.	Time. Hrs.	Total thickness of scale. Mm.	Percentages of total.		
			FeO layer. Per cent.	Fe_3O_4 layer. Per cent.	Fe_2O_3 layer. Per cent.
520	3.0	Not measurable.			
620	0.25	0.004	23	65	12
750	0.25	0.021	82	7	11
900	0.25	0.052	79	11.5	9.5
Electric - welded conduit ..		0.018	76	16	8
Hot-rolling scale, 1,000 deg. to 900 deg. C. ..		0.018	83	17	—

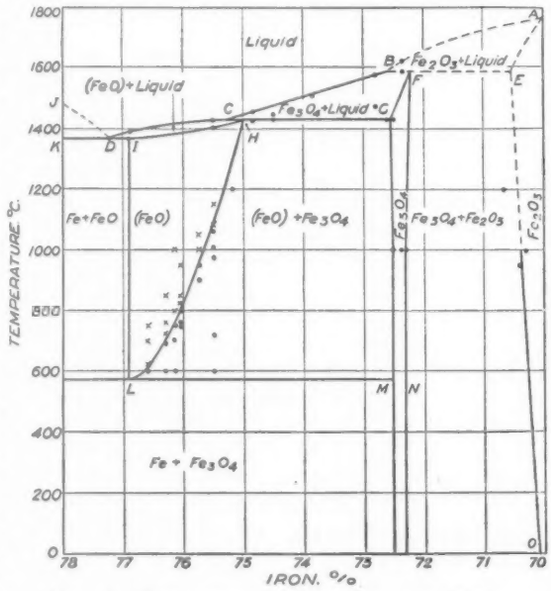


Fig. 1.—Equilibrium Diagram of the Iron-Oxygen System from 70 to 78 per cent. Iron.

Physical Chemistry of Pickling.

Diverse theories have been proposed to explain the removal of scale during pickling, but none of them seems to be free from objection. Thus, it has been claimed by some that acid dissolves scale, but it is common observation that a scale sludge accumulates in pickle tanks in the course of working. Others have maintained that scale is negligibly attacked by the acid, but that the vigorous action on the underlying steel, to which access is gained by cracks and pores, leads to mechanical bursting-off of the scale layers. If this latter is the only factor, there is no explanation of the removal of scale by acid containing a restrainer in sufficient amount to reduce the attack of steel to negligible proportions. Still others have claimed that there are fundamental differences in the mode of action of different acids.

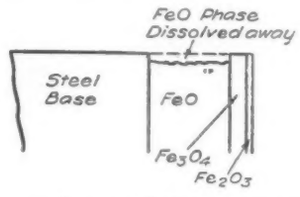


Fig. 2.—Sketch Indicating Selective Attack of Scale Layers.

The diversity and contradictory nature of these theories appear to have been largely due to a lack of knowledge of the constitution of the scale coating. From the etching properties of the various scale constituents it would seem reasonable to infer that the inner ferrous-oxide phase layer dissolves in pickle acid comparatively quickly, whilst the oxygen-rich phases, magnetite and ferric oxide, are practically unattacked. Experiments were made to investigate this point.

Etching Experiments.—Two small pieces of mild steel were scaled by heating in air at 900 deg. C. for 24 hrs. and slow cooling. The faces were then polished, every care being taken to avoid cracking-off the coating. In this way, sections of scale *in situ* were prepared and examined. Parts of the sections considered to be typical were then selected, marked, examined and photographed after short progressive periods of exposure to pickle acid containing a sufficiency of inhibitor. A series of observations, using 50 grm. per litre hydrochloric acid at 25 deg. C., were made with one specimen, whilst the other was employed for a similar series, using 50 grm. per litre sulphuric acid at 50 deg. C.

In both cases it is to be noted that rapid attack of the ferrous-oxide phase layer has occurred, but that the oxygen-rich layers comprising the magnetite and ferric-oxide phases show only slight corrosion, and, in the later stages, a certain amount of disintegration. There are no very obvious differences in the action of the two pickles, which were used at different temperatures in order to obtain approximate similarity in the rate of action.

After an hour's exposure to the action of the acid, the extent of the attack and removal of the inner layer of scale was sufficiently marked to be easily distinguishable by the naked eye (Fig. 2).

Quantitative Pickling Experiments.—In order to investigate the nature of the processes still further, quantitative pickling experiments were made with the two acids. Short lengths cut from the same scaled tube were weighed and exposed to the pickle for a time sufficient to

* A paper read before the Autumn Meeting of the Iron and Steel Institute.

remove the scale, the evolved hydrogen was collected and measured, the tube was washed, dried and weighed, and the undissolved scale was also collected, washed, dried and weighed. The iron in the solution and the free acid remaining were likewise determined. With the data thus obtained, by making a few simple and apparently reasonable assumptions (for instance, that hydrogen was evolved equivalent to the attack on the steel base), it was possible to draw up an approximate statement for each experiment showing the weight of scale removed, the proportion actually dissolved and the proportion merely detached. The experimental data and calculated results are detailed in Table II.

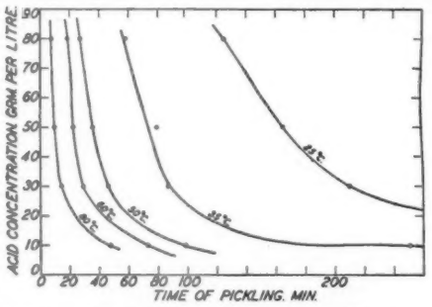


Fig. 3.—Sulphuric-Acid Pickling. Pickling-Time/Acid-Concentration Isotherms for 25, 35, 50, 60 and 80 deg. C.

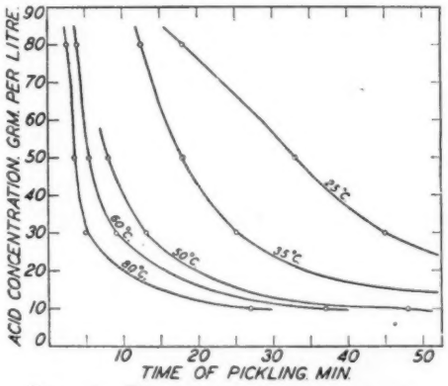


Fig. 4.—Hydrochloric-Acid Pickling. Pickling - Time/Acid - Concentration Isotherms, for 25, 35, 50 and 80 deg. C.

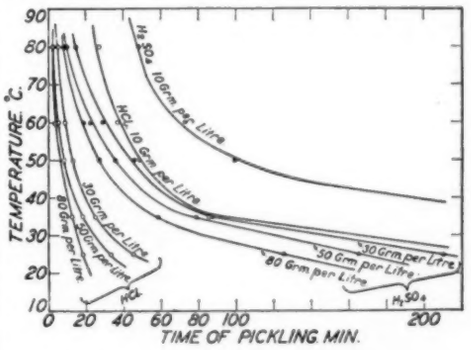


Fig. 5.—Temperature/Pickling-Time Graphs for Sulphuric and Hydrochloric Acids at Concentrations of 10, 30, 50 and 80 grms. per Litre.

Table II.—*Pickling Experiments.*

	H_2SO_4 pickling.*		HCl pickling.†	
	Scaled at 750 deg. C. (With glue size.)	Scaled at 900 deg. C. (No re-strainer.)	Scaled at 750 deg. C.	Scaled at 900 deg. C.
			(With glue size.)	
Weight of scale per unit area, grm. per sq. cm.	0.0095	0.017	0.0095	0.018
Average thickness, mm. ..	0.021	0.052	0.021	0.052
FeO phase, per cent. of total..	82	79	82	79
Fe_3O_4 phase, per cent. of total..	7	11.5	7	11.5
Fe_2O_3 phase, per cent. of total..	11	9.5	11	9.5
Proportion dissolved, per cent.	92	85	95	90
Iron content of portion dissolved, per cent.	80	80	77	76
Steel base dissolved, grm. per sq. cm. ..	0.0003	0.001	0.0002	0.0002

* 30 grm. of H_2SO_4 per litre at 55 deg. C.
† 30 grm. of HCl per litre at 25 deg. C.

So far the experimental work had been directed towards discovering the mechanism of pickling, but the kinetics of the process, besides having further bearing on this question, are of even greater practical importance as a pickling solution after all is discarded when its action becomes too slow and/or it is too dirty, or, more exactly, when further additions of acid to maintain activity would be less economic than making up a new solution. Further experiments were therefore made with the object of discovering the effects of various factors on the time required to pickle a standard material.

Kinetics of Pickling.—The chief variables that would be expected to affect the time of pickling are the nature and concentration of the acid, the temperature, the state of agitation, the concentration of iron salts, and the nature and amount of inhibitor. Annealing scale produced under works and even ordinary laboratory conditions was found to vary so much in amount, probably by reason of the difficulty of exactly reproducing all conditions, that the use of such scaled material was abandoned. Instead it was found that a type of conduit produced by an electric-welding process provided a much more satisfactory scaled test-piece, and enabled investigations of the effects of the other variables to be made. The results obtained apply specifically to the particular steel and conditions of scaling used, but it appears reasonable to believe that they are of general application.

A large number of determinations of the time required to pickle short lengths of this standard material were made, with systematic variations in the pickling conditions. To portray the effects of alterations of the factors individually a number of graphs have been drawn based on the results recorded in Tables III and IV. Thus, Fig. 3 shows the effect of the acid concentration at various temperatures on the pickling time, giving pickling - time/acid - concentration isotherms for 25, 35, 50, 60 and 80 deg. C. for dilute sulphuric acid. Similar graphs for dilute hydrochloric acid are given in Fig. 4. Above 30 grm. per litre* it is seen that the pickling time varies in a practically linear manner with the concentration. Fig. 5 shows the effect of the temperature on the pickling time for four concentrations of the same acids, namely, 10, 30, 50 and 80 grm. per litre. In Fig. 6 the same data have been plotted, using a logarithmic scale for the pickling time and a reciprocal scale of the absolute temperature. The preponderating influence of the temperature in determining the pickling time is well shown in these two graphs, as well as in Fig. 7, where lines of constant pickling time have been drawn on a concentration-temperature basis. These lines are contours of the surface in a solid model relating the pickling time with the concentration and temperature of the acid.

* It should be noted that the figure for grm. per litre is the same as for lb. per 100 galls.

Effect of Common Ion on Pickling Time.—The effects of progressive additions of ferrous sulphate in the case of sulphuric acid on the pickling time are given in Table V, and shown graphically in Fig. 8. At similar activities the effects of iron salts seem to be similar for both acids. The retarding effect is most pronounced when the pickling is already slow by reason of low temperature and/or acid concentration.

Effect of Inhibitors on Pickling Time.—Various proprietary restrainers in recommended amounts were found to have closely similar retarding effects (Tables VI and VII). They were also found to be practically equally effective in restraining the attack on bare steel at the recommended concentrations (Table VIII).

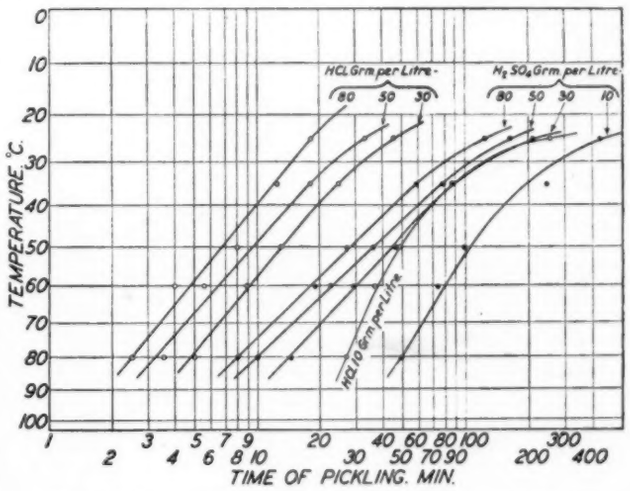


Fig. 6.—Temperature/Pickling-Time Graphs Plotted to a Reciprocal Absolute-Temperature Scale, and a Logarithmic-Time Scale.

Effect of Material on Pickling Time.—A few experiments were made to determine how the pickling of annealed material compared with the standard conduit used for the main investigations. These are given in Table IX.

(To be continued.)

The Stanton Ironworks Company, Limited, Nottingham, is now making 30 miles a week of 3-in. and 4-in. dia. Stanton Delavaud spun-iron pipes.

Nickel Cast Iron in Diesel Engines.*

Since the beginning of the present century the Diesel type of internal-combustion engine has developed rapidly and has come to the forefront as one of the most efficient, reliable and adaptable prime movers available. The convenience of storing and handling oil fuel, as compared with coal, stimulated the application of this type of engine to marine propulsion and, in fulfilling modern requirements for large power units both on land and sea, the size of the engines has grown until, to-day, units up to 15,000 h.p. are in service, and an engine of 22,500 h.p. is now under construction. On the other hand, economic considerations have led to a growing competition between the smaller types of Diesel engine and the petrol engine. The result has been the development, in the last two or three years, of the smaller high-speed Diesel unit now finding increasing application for road transport, light railways, smaller marine applications, agricultural engineering and a variety of other general purposes.

Fig. 1.—Group of Alloy Cast-Iron Diesel Liners Hardened by Heat-Treatment.

In the construction of Diesel engines of all sizes cast iron figures largely, all the more massive parts, such as frames, cylinders and heads, pistons, etc., being generally manufactured from iron castings. In this, as in other fields of engineering endeavour, progress has created a demand for improved materials, and Diesel engineers have welcomed the possibilities of adopting the newer special cast irons to assist them in overcoming some of the troubles met under modern conditions. Special cast irons are now available which not only provide the solution of such production difficulties as unmachinability or porosity, and such service troubles as wear and growth under heat, but also offer the possibility of reducing scantlings in virtue of their higher strength, this latter point being of vital importance in many applications. The special cast irons are also finding increasing application for many smaller details and accessories in Diesel-engine construction. Among the special cast irons, those resulting from the use of alloy additions, especially nickel, have proved of the greatest interest. The addition of nickel to suitable cast-iron bases has led to the development of three distinct classes of castings. In the first place, small additions of nickel (0.5 to 2.0 per cent.) under suitable conditions show great benefit in improving the all-round quality of the castings; the grain of the iron is refined, strength is increased and pressure-tightness is ensured, while resistance to wear and heat are also much improved. The irons are readily machinable and are particularly noteworthy for their remarkable uniformity throughout thick sections and in castings of varying section.

Fig. 3.—Group of Liners and Pistons for small High-Speed Diesel Engines.

Secondly, somewhat higher additions of nickel (up to 6 per cent.) are used to give a martensitic structure in the iron whereby the castings, although still grey, are very hard, having special advantages where wear-resistance is required. The desired hardness may be combined with toughness by suitable heat-treatment, as in the case of the steels. In the third place, high additions of nickel (over 15 per cent.) give an austenitic structure to the iron, in virtue of which the castings show a marked degree of heat- and corrosion-resistance, while they have interesting expansion and other physical properties.* Use has been made of all these grades of nickel cast iron in recent development in Diesel engines and some of the applications are dealt with in detail below.

Fig. 2.—Group of Nitri-Cast-Iron Liners. An Alloy Cast Iron including Nickel is used for these Liners, which, after finishing, are surface-hardened by the Nitrogen-Hardening Process.

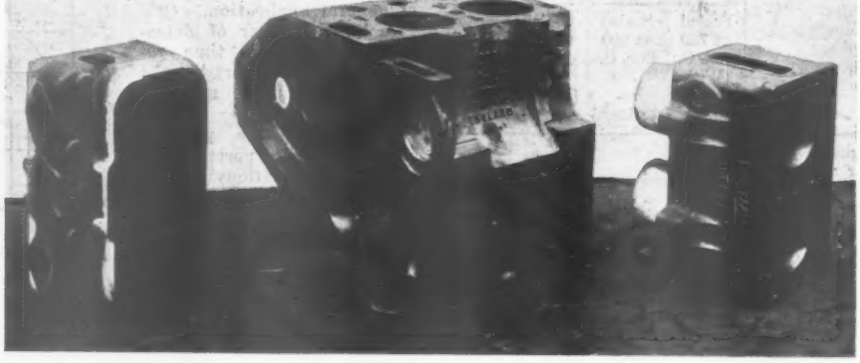


Fig. 4.—Nickel-Cast-Iron Cylinder Block Head and Crankcase for High-Speed Diesel Engines.

Liners.

Although steel is sometimes used for Diesel-engine cylinder liners, cast iron is more generally employed. This is an application in which the good wearing quality of cast iron is of special value and constitutes one of the principal reasons for its adoption in preference to alternative materials. The conditions of service in a cylinder liner are so severe, however, that wear always occurs to a greater or lesser extent, causing loss of power and efficiency, and involving inconvenience and expense in shut-downs, overhauls and repairs. On account of its general high quality, nickel cast iron has been tried out in this connection and has been found successful, having a wear resistance superior to that of ordinary iron, while the strength and toughness of the alloyed castings have ensured freedom from such troubles as cracking and fracture which have been encouraged with some other types of material.

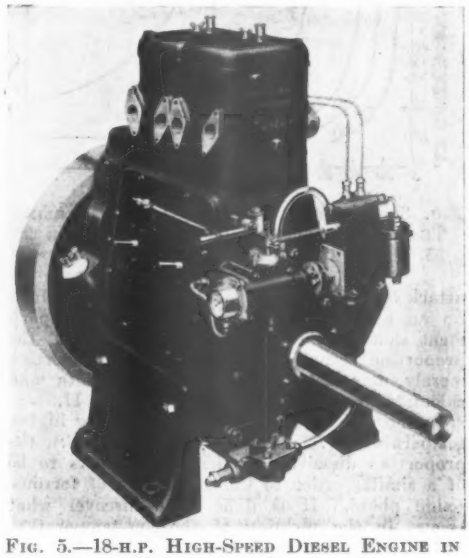


Fig. 5.—18-h.p. High-Speed Diesel Engine in which Nickel Cast Iron is used.

In a recent test, nickel cast iron (1.25 per cent. nickel) was used for one cylinder liner in a large two-cycle marine Diesel engine. After 70,000 miles at sea, this liner showed a maximum wear of 52 thousandths of an inch compared with an average maximum wear of 70 thousandths shown by the unalloyed liners normally used. The accompanying illustrations show a variety of nickel cast-iron liners as adopted by various manufacturers, who report that these liners have excellent quality, possessing a very dense grain and freedom from porosity whilst exhibiting a mirror-like finish. Special problems are met in the case of the newer high-speed Diesel engines, as used for road transport, marine and general applications, where a small portable

* Extracted from Publication B.10 of the "Bureau of Information on Nickel."

* Further detailed information on all these classes of iron is contained in the "Bureau of Information on Nickel," Publications B.7, B.8, B.9 and B.11.

unit is required. The castings for this type of engine are in many respects similar to those employed in the construction of the petrol engine as applied to commercial transport, the cylinders and water jackets being generally cast integrally in one cylinder block. In the case of such castings the addition of 1 or 1½ per cent. of nickel has proved of the greatest possible benefit in production, ensuring uniform machinability throughout the various sections of the castings, with density and pressure tightness (see Figs. 4 and 5).

As in the case of the ordinary automobile engine, liners are available for insertion into the cylinders to restore the working surface after it has been damaged by wear. Some

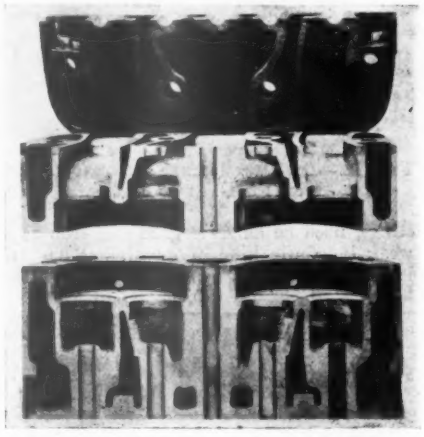


Fig. 6.—Sections of Nickel-Cast-Iron Cylinder Head for small High-Speed Diesel Engine.

manufacturers, indeed, prefer to insert a dry liner as part of the normal construction of the engine and not to depend on the cylinder wall of the original casting. In other types of construction wet liners are used. The martensitic type of cast iron, mentioned above as the second group of alloy cast irons produced by the addition of nickel, is of special interest in connec-

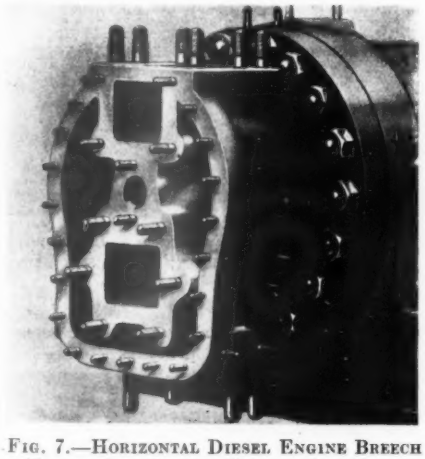


Fig. 7.—Horizontal Diesel Engine Breech End in Low-Silicon Nickel Cast Iron.

tion with the problem of liner wear. As discussed elsewhere,* the hard structure can be obtained in a casting either by the use of about 5 per cent. of nickel in a suitable base iron, with or without a small proportion of chromium, or by the heat-treatment of suitable compositions of nickel-chromium cast iron (for example, 2½ per cent. nickel, 1 per cent. chromium), the treatment consisting of a quench in oil from between 800 deg. C. and 900 deg. C., followed by tempering (see Fig. 1). Cylinder liners manufactured by both processes have been in service, and so far have given very promising results. Judging by the results obtained over longer periods in petrol-engine practice, where this iron has proved remarkably successful, it would appear that it would prove very suitable for Diesel-engine liners of all types. The martensitic class of cast iron is slightly more difficult to machine than metal having the ordinary structure, and, for this reason, some manufacturers prefer to use the softer grade of alloy, hardening it by heat-treatment after machining.

* See "Bureau of Information on Nickel," Publication B.11, "Heat-Treatable Grey Cast Iron."

Cylinder Heads and Breach Ends.

Cylinder heads and breach ends are almost invariably extremely complex in shape, being designed to carry the air inlet, exhaust valves and fuel injectors, while the castings are further complicated by the water jacket which is necessary round the parts liable to attain high temperatures in service. The conditions under which the castings operate are also very severe, certain parts being subject not only to high temperatures, but also to the repeated impact of the valves; the whole casting must, moreover, be rigid and strong to withstand the very high pressures developed in the cylinder during the working stroke. Cast iron is generally used, but trouble is frequently encountered, in production, with porosity and leakage in some of the heavy sections and junctions of sections. In service, growth of the casting at the high temperatures involved sometimes leads to serious trouble with distortion and even cracking. In this application, cast iron alloyed with both nickel and chromium (1.25 per cent. nickel, 0.5 to 0.75 per cent. chromium) is found particularly suitable, the combined addition conferring heat-resistance, together with the necessary degree of toughness and machinability, density and pressure tightness.

Figs. 6 and 7 illustrate types of cylinder heads in which nickel cast iron has proved successful. The former shows the head of one of the newer small high-speed engines, and the latter the head of a larger type of horizontal Diesel engine.

Pistons.

Some of the problems connected with pistons are similar to those involved in heads. A hard, strong iron is required which must be heat-resistant in the crown, and, at the same time, dense and wear-resistant in the skirt. The nickel-chromium type of cast iron, as specified above, is found generally suitable. In many of the larger types of engine it is now common practice to use a loose head on the piston. This enables the most suitable metal to be used for the crown, and also facilitates replacement should the crown become fractured or eventually show deterioration. The high-alloy austenitic types of cast iron, such as "Ni-Resist" or "Nicrosilal," which come under the third group of alloy cast irons mentioned at the beginning of this article, have been found of interest for use as pistons. Fig. 8 shows a larger size of piston in which the piston body is made of low-nickel cast iron as above, whilst the loose crown is attached, this being made in the special high-nickel cast iron indicated.

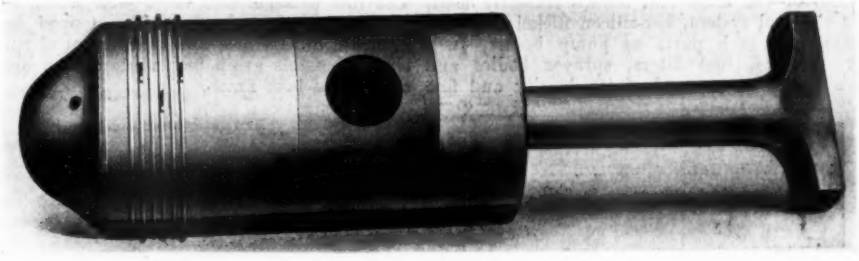


Fig. 8.—Piston with Nickel-Cast-Iron Skirt and "Ni-Resist" Crown.

Valve Sleeves.

In certain types of Diesel engine, sleeve valves are employed, and, for such parts, nickel cast iron is used to ensure good finish and wearing quality, with other necessary properties such as strength and heat-resistance.

Piston Rings.

There is a wide divergence of opinion concerning the optimum properties required in cast-iron piston rings for Diesel engines. In some cases it is considered most satisfactory to work a hard cast iron and in others to use a soft grade of metal. In either case, however, it is essential to have a ring uniform in structure, dense and elastic. Such properties are shown by the nickel cast irons, the actual degree of hardness being easily varied by control of the nickel content or by the use of chromium. Alloy cast iron containing about 2½ per cent. of nickel with a small proportion of chromium has been used for rings which have been hardened and tempered by heat-treatment. In this case a ring of high strength and elasticity is obtained, with a Brinell hardness number approaching 400. Under this heading, mention might also be made of liner foot sealing rings for which the austenitic type of cast iron has proved particularly suitable on account of its physical properties and corrosion-resistance.

Fig. 9.—Diesel Engine Exhaust Manifold in Nickel-Chromium Heat-Resisting Cast Iron.

Exhaust Manifolds.

Nickel or nickel-chromium cast iron has been used in some cases for exhaust manifolds, especially in the smaller Diesel engines. The reason for the adoption of the special alloy iron is generally to ensure a strong, tough readily machinable casting with a degree of heat-resistance, since in some types of engines the manifold

is liable to become very hot when the engine is running for some time under load. Growth and distortion of the manifold, with possibly fracture of the flanges held by the bolting-down bolts, is thus prevented. (See Fig. 9.)

Fuel System.

In Diesel-engine construction there are a large number of smaller castings used in connection with the fuel system, starter system and various accessories. In some cases nickel cast iron has been adopted to replace parts machined from steel, while in others a high alloy austenitic cast iron has been employed as a cheap substitute for the brass and bronze formerly used.

In the fuel system, low-silicon nickel cast iron is used for such parts as pump bodies, fuel-valve needles, fuel filters, sprayer bodies and valve bodies on account of its density and fine grain. Figs. 10 and 11 show some of the casting referred to above. The fuel-valve body is of special interest, since this is replacing a part originally made from a steel forging. The photograph illustrates a rough casting through which a hole has been drilled for inspection purposes. The diameter of the shank when finished machined is 2½ in. A ⅜-in. dia. hole is reamered right through the centre of the shank and flange. This hole has to be absolutely mirror-like in finish and the slightest porosity under a pressure test of 14,000 to 16,000 lb. per sq. in. causes the casting to be rejected. This test result is particularly difficult to attain in view of the awkward shape of the casting and the tendency to porosity where the shank joins the flange. With the use of the nickel pearlitic cast iron, no trouble whatever has been met. The fuel-valve needle illustrated above is a part which was originally made in case-hardened steel, but trouble was experienced with pitting and erosion. A large number of needles, as shown, have now been supplied in pearlitic nickel cast iron and have given entire satisfaction.

The cast-iron sprayer bush shown in Fig. 11 calls for some comment. The bore of the bush is reamered and then burnished with a special tool so as to take the sprayer plunger with an absolutely perfect fit. All sprayer bushes and plungers in this particular type of engine have to be completely interchangeable. There is a very fine thread (60 threads per inch) on the sprayer bush, which acts as a filter and stops any dirt exceeding four thousandths of an inch in size, present in the fuel oil. It is reported that no other material has been found so satisfactory for this part as the low-nickel alloy cast iron.

The sprayer bodies shown in Fig. 12 are of particular interest, since they are made as die castings in metal moulds. After casting they are annealed to render them fully machinable and the desired properties finally obtained by oil-hardening and tempering after machining. A nickel-chromium alloy cast iron is employed. The fuel passages and valve faces which are cut in this casting have to be lapped to very accurate dimensions, and it is essential that the closest possible grain be maintained in order to obtain the best finish.

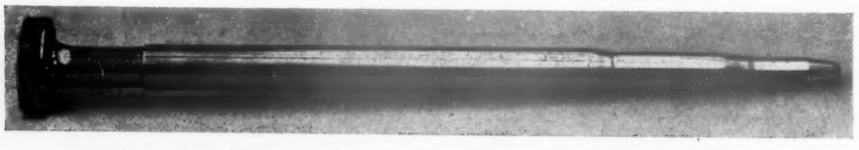


Fig. 10.—Nickel-Cast-Iron Diesel Engine Fuel-Valve Needle.

Starter System.

In the starter system again, a number of incidental castings are required for such parts as the starter body and starter valves, the essential requirement for these parts being pressure tightness, together with corrosion-resistance, so that, after standing for a time, perfect operation is obtained on the part of the valves when they are called into service. Brass and bronze have sometimes been used for these parts, but, as a measure of economy, the high-nickel austenitic cast iron is now adopted as giving equivalent service for less cost. Fig. 14 shows an air-bottle valve in "Ni-Resist," and also an air-starter body, used for horizontal four-stroke engines, cast in the same alloy. The castings are tested to an air pressure of 500 lb. per sq. in., the working pressure being 350 lb. per sq. in. In this case "Ni-Resist" has replaced phosphor bronze.

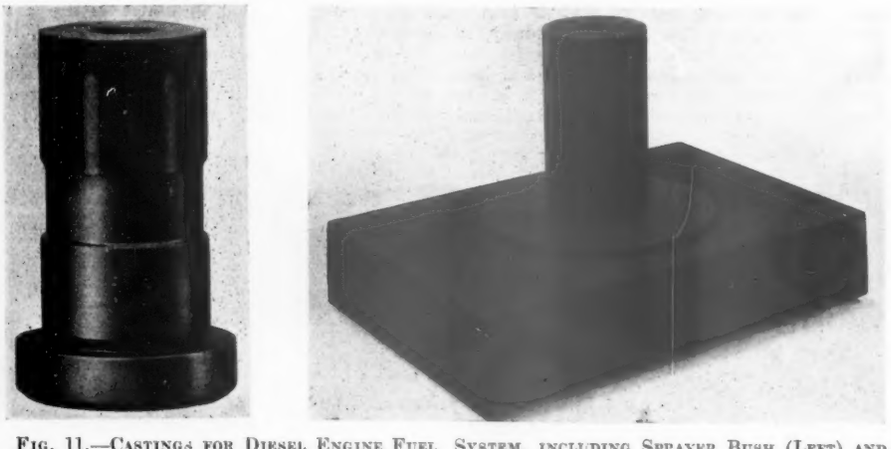


Fig. 11.—Castings for Diesel Engine Fuel System, including Sprayer Bush (Left) and Fuel-Valve Body, both in Nickel Cast Iron.

Many other small miscellaneous castings in connection with Diesel-engine construction are made in nickel cast iron. Alloy cast-iron bar, suitable for the manufacture of gears, bushes, etc., which can be subsequently hardened by heat-treatment, is now available, and Fig. 13 shows a number of gears made from this metal.

Conclusion.

This article serves to emphasise the very wide application of nickel cast iron in modern Diesel-engine practice. In this field, perhaps more than in any other, modern conditions demand modern materials. The engineer, when faced with the problem of selecting materials for his castings, need no longer regard cast iron as just a weak indefinite kind of metal, but has available a wide range of cast irons from which he can choose, and in which, by the use of alloy additions and heat-treatment, a very wide and useful series of properties is available to meet many of the more rigid and specialised demands of modern Diesel-engine practice.

Fig. 12.—Die-Cast Nickel-Chromium Cast-Iron Fuel-Valve Bodies.

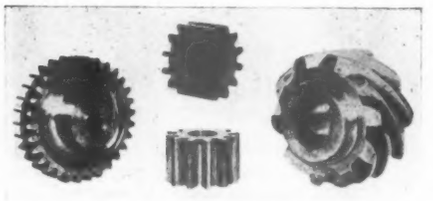


Fig. 13.—Heat-Treated Nickel-Chromium Cast-Iron Gears.

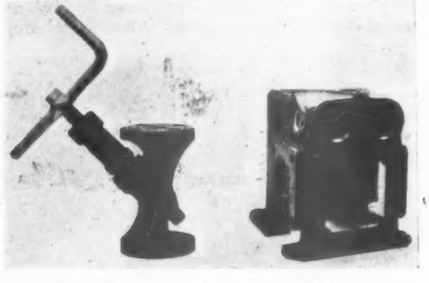


Fig. 14.—Starter Valve and Body both cast in "Ni-Resist," Bronze being replaced.

New Welland Canal.—The completion of this canal, on which work was begun just before the outbreak of the war, is regarded as one of the greatest achievements in Canadian history. Four Welland canals have been built since the idea of linking Lake Erie with Lake Ontario was first suggested in 1829. The difference between the first and fourth canals is shown by the fact that the number of locks has been reduced from 40 to eight, and the length of the locks has been increased from 110 ft. to 820 ft., their width from 22 ft. to 80 ft., and their depth from 8 ft. to 30 ft. Each lock now has a lift of 46½ ft., yet can be filled in eight minutes. The total weight of the lock gates is 23,000 tons, and the total lift of the canal, in its length of 25 miles, is 326½ ft. The estimated cost of the whole work is $130,000,000 (over £26,000,000 at par).

Book Reviews.

Engineering Educator, edited by W. J. Kearton, M.Eng. To be published in about 30 fortnightly parts by Sir Isaac Pitman & Sons, Limited, Parker Street, Kingsway, London, W.C.2. Price 1s. 3d. each part.

An excellent method of acquiring a comprehensive text-book on engineering is disclosed by an advance copy of Part 1 of the above series. One pays a penny a day and in 14 months one possesses a really worth-while compendium on engineering subjects. Part 1 covers in 48 pages the subject of mathematics for engineers, an essential yet, unfortunately, dull subject for many of us. Yet we would not have it otherwise. We know personally many of the authorities chosen as contributors, and we congratulate the Editor on his selection. Naturally, patternmaking and moulding are to be covered, and these are left in the capable hands of J. McLachlan and Chas. Otto.

Introduction to Metallography, by Prof. Paul Goerens, Dr. Ing., Dr. Phil. Sixth Edition. Published by the Verlag von Wilhelm Knappe, Halle (Salle), Germany. Pages 392 + xvi. Illustrations 485 in text, with special frontispiece of microphotographs printed in natural colours. Price with cloth covers, 17 R. mks.; with paper covers, 15.50 R. mks.

Of all the text-books on metallography which were in existence twenty years ago the early edition of Goerens' "Introduction to Metallography" found the greatest favour amongst those metallurgists primarily interested in iron and steel metallurgy. The first edition was translated into English by Mr. Fred Ibbotson as long ago as 1908. Since this time the work has run through five editions, during which it has been revised and so completely reconstructed that practically all traces of the early editions are quite lost. The only traces of the early edition which one recognises in glancing through the pages are those illustrations of the photomicrographs of various structures which exist in the iron-carbon alloys, including those pictures of the eutectic structure and the hypereutectic structure, which have never been excelled by the most modern worker, in spite of the high state of development which the art of photomicrography has attained during recent years.

The book is divided into three main sections: a theoretical section, a practical section and a section devoted to the metallography of the technical iron-carbon alloys. The former section is devoted to the consideration of the constitution of alloy systems of the binary and ternary character, and opens with a short consideration only of the principles of cooling and crystallisation. These are dealt with in the most concise possible manner, and amply illustrated by examples drawn from some of the common non-ferrous alloy systems. As if in final illustration of the constitution of alloy systems, the first section is closed by devoting almost half its allocation of pages to a most comprehensive and exhaustive collection of the constitution diagrams of the iron alloys.

It is this happy choice of illustrations drawn from iron and its alloys that so endears the author and his work to those interested in ferrous metallurgy. The collection includes twenty-one diagrams of binary alloy systems involving iron as one component and six ternary iron carbon-alloy diagrams, and the references show that these have been brought quite up to date (1929). This authoritative collection in itself is possibly unique amongst the various text-books on metallography available and is of inestimable value to all metallurgists.

In the second section the experimental methods of the investigation of alloy systems are treated thoroughly. The section on melting methods has been brought up to date by the inclusion of the high-frequency furnace. Methods of thermal analysis, X-ray analysis and microscopic analysis are dealt with exhaustively in this section. The absence of any treatment of the methods of magnetic, thermo-electric and electrical-resistivity analysis as applied to alloy systems is very noticeable.

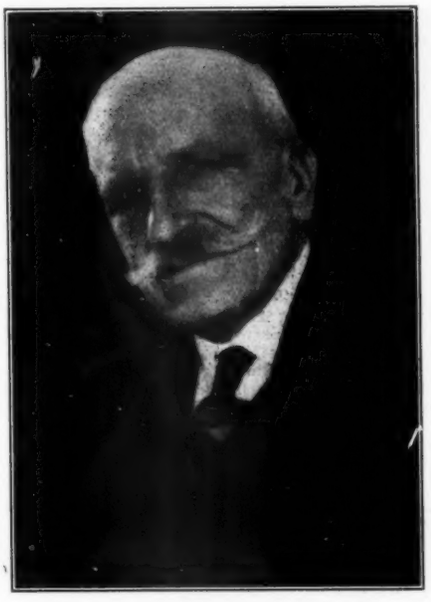
The final section is of great value to all those interested in iron and steel metallurgy. Here the author presents a most comprehensive survey of the metallography of iron and steel alloys. This section alone is illustrated by over one hundred photographs and diagrams which refer to the structures, properties, faults, defects, inclusions in ferrous alloys from cast iron to the complex alloy steels. All the photographs and illustrations are of a very high standard of excellence. The book as a whole is well indexed and the whole of the references are collected together in a very complete separate section. Printed on excellent paper and in a very readable type, the book can be highly recommended to all those interested in the technology of iron and steel in addition to students of metallography. The clear, concise and eminently practical treatment of this subject is quite refreshing in these days.

J. E. H.

Iron and Steel Institute.

Mr. W. R. Lysaght President-Elect.

Mr. W. R. Lysaght has been selected by the Council of the Iron and Steel Institute to succeed



Mr. W. R. Lysaght.

Col. Sir Charles Wright, Bt., as President at the termination of his year of office at the annual meeting next May. Sir Charles, in making this announcement at the recent autumn meeting in London, said the appointment would, he was sure, be heartily welcomed by all the members of the Institute. Mr. Lysaght was a very old and valued friend of his own and of many of the members, and the office of President would be enriched by his appointment. He was connected with many of the great trades of this country, and there was no one who had a greater and more practical knowledge of the steel industry.

B.S. Specification for Cast Iron Light Rainwater Pipes.—The British Standards Institution has issued a Specification for Cast Iron Spigot and Socket Light Rainwater Pipes (Cylindrical). This is the sixth specification of a series dealing with cast-iron pipes, and represents the first step towards national standardisation in light rainwater goods. Copies of it (No. 460—1932) may be obtained from the Publication Department of the Institution, 28, Victoria Street, London, S.W.1. Price 2s. 2d. each, post free.

Institute of Metals.

PROGRAMME FOR THE COMING SESSION.

The Institute of Metals has just issued a comprehensive programme of meetings to be held during the ensuing 12 months. Apart from the General Meetings of the Institute the programme includes particulars of over 40 lectures and addresses to be given before the six Local Sections of the Institute, which are centred, respectively, in Birmingham, Glasgow, London, Newcastle-upon-Tyne, Sheffield and Swansea. These lectures are of an essentially practical character, being intended to appeal particularly to workers engaged in local industries. Thus, among the Papers to be read before the Birmingham Local Section, will be those on "Heat-Treatment without a Detrimental Finish" and "Welding of Copper." The London Local Section is fortunate in having an address by the President of the Institute, Sir Henry Fowler, K.B.E., LL.D., D.Sc., on "Non-Ferrous Metals and Alloys in Railway Engineering"; there will also be an open discussion on "Non-Ferrous Metals in the Food Industry," this constituting a joint meeting with the Food Group of the Society of Chemical Industry. The programme of the Glasgow Section includes—as befits a marine centre—a Paper on "Modern Light Alloys, with particular reference to Corrosion." Similarly, before the North-East Coast Local Section, which is centred at Newcastle-upon-Tyne, there will be given a Paper on "Corrosion of Metals in Salt Solutions and Sea-Water," this being a joint meeting with the Society of Chemical Industry. Sheffield members—being particularly interested in the electro-plating industry—will hear with special interest a lecture by a Vice-President of the Institute, Mr. W. R. Barclay, O.B.E., on "Nickel Silver Alloys for the Electro-Plate Trades"; whilst before the Swansea Local Section there will be presented an essentially practical Paper on "Rolling," which should appeal to workers in this Welsh metallurgical centre. Copies of the complete programme may be obtained on application to the Secretary, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, London, S.W.1.

Publication Received.

Bridging the Gap.—The Manchester Association of Engineers, St. John Street Chambers, Deansgate, Manchester, has issued a 12-page propaganda leaflet. It is particularly well written and printed, so much so, that it is well worth emulation by other engineering and metallurgical societies. The Association has consistently done good work since its inception in 1856. The great advantage of such a society is that it is small enough for the average member to let the Council know his needs, and big enough for the Council to obtain the very best people to lecture with a view to satisfying those desires. Our northern readers should write to the secretary, Mr. T. Makemson, for a copy of this brochure.

Wood-Coated Steel Sheets.—Flex-metal, made by the Flexwood Company, 4413, West Division Street, Chicago, consists of a No. 16 to No. 28 gauge galvanised sheet to one side of which a wood veneer only 1/100th in. thick has been applied under pressure. Sheets coated with wood veneer vary in dimensions with the sizes obtainable in thin slices of various woods. In most cases, lengths are about 96 in. and occasionally 120 in. Widths, however, are 30 to 36 in. in rotary-cut walnut surfacing, 10 to 16 in. with sliced walnut, 8 to 12 in. for ribbon mahogany, an average of 15 in. with flat-cut mahogany or prima vera, and 10 to 15 in. in flat-cut oak.

This Week's News in Brief.

Trade Talk.

Messrs. John I. Thornycroft & Company, Limited, Southampton, have booked an order for an 800-ton Diesel-engined cruising yacht.

The Taylor Stoker Company, Limited, have removed from Bush House, Aldwych, London, W.C.2, to Park House, Great Smith Street, S.W.1.

The employees of Messrs. Anderson, Boyes & Company, Limited, Flemington Works, Motherwell, have contributed during the past year £202 17s. to various charitable institutions.

The Brush Electrical Engineering Company, Limited, have received an order from the Douglas (I.O.M.) Corporation Electricity Works for a 1,500 kw. Brush-Ljungstrom turbo-generator set, with condenser, etc.

A further shipment of steel rails for Canada left Middlesbrough last week-end, the "Cairndhu" sailing with about 600 tons on board. The vessel also carried between 500 and 600 tons of steel plates and angles.

Mr. H. A. Esden, of Messrs. Davie Parsons & Company, has been appointed receiver for the first debenture holders for Ealing Park Foundry, Junction Road, South Ealing, London, W.5.

Efforts are being made to secure financial support for a project to utilise the Gateshead railway shops of the L.N.E.R. for the manufacture of locomotives for export. A decision has been made to close the shops, 600 men being affected.

Presiding at the annual meeting of Qualcast, Limited, Mr. J. E. V. Jobson said that, if they took the margin between cost and selling price of their foundry products during the 1931 period as 100, the margin in the figures under review was only 55.

The business of R. W. Collin & Company, Long Bank Foundry, Sunderland, has been transferred to the Pallion Foundry, Saint Luke's Road, Sunderland. The telephone number is Sunderland 4987. The premises at Long Bank Foundry have been closed.

Whilst the lining of a blast furnace at the Govan Iron Works of Messrs. William Dixon, Limited, Glasgow, was being removed preparatory to rebuilding was in progress the scaffolding collapsed and four men were injured. After treatment at the infirmary three of them were allowed to go home, but the fourth man was detained.

A 2,300-ton vessel, built for the Wandsworth Gas Company, London, has been launched by the Burntisland Shipbuilding Company. The "Wandle" is one of several which have been built for the same owners, and is the largest steamer yet constructed for trading on the Metropolitan section of the River Thames. The propelling machinery is being supplied by the North Eastern Marine Engineering Company, Limited, Wallsend.

At an adjourned meeting of the Coatbridge Valuation Appeal Court, it was agreed to reduce the valuation of Summerlee Iron & Chemical Works to pre-war figures, subject to de-rating. The assessor strongly emphasised that the reduction was granted solely on the facts of this particular case, and that it must not be regarded as a precedent implying wholesale resort to pre-war figures.

The Tata Iron & Steel Company, of Jamshedpur, India, are erecting one of the most modern sheet mills. The whole of the plant is being built in America, with the exception of the pickling, which is being manufactured by Messrs. Taylor & Sons, Limited, of Briton Ferry, who are supplying their latest 1932 four-vat patent pickling and swilling machine, which was selected from all other machines on the market. The plant is expected to be in operation early in the New Year for the production of galvanised sheets.

The first steamer built for the Battersea Power Station to the order of the London Power Company, Limited, the s.s. "Alexander Kennedy," has been specially designed by the Burntisland Shipbuilding Company, Limited, for the transport of coal, principally from Scottish ports to the Metropolitan section of the Thames. She has just completed very successful trials in the Firth of Forth. In view of the twelve low-span bridges, with their varying and unusual contours, that must be negotiated in the up-river and return passage, the funnel and mast is arranged to lower, and the wheel-house is of collapsible construction.

The Burntisland Shipbuilding Company, Limited, have secured an order to build a new steamer for London owners. The vessel is to have a deadweight of 1,150 tons. Throughout the present year when so many shipyards have been idle the Burntisland firm have been fairly well employed. Since November, 1931, they have secured six orders for cargo steamers, and since the beginning of the year they have launched three vessels, including a large "Economy" type steamer for the Alexander Shipping Company. Owing to the remarkably low fuel consumption of the "Economy" steamers all the vessels of this type built in recent years have been able to operate economically even in the worst periods of the shipping depression.

We are informed by Monel-Weir, Limited, Cathcart, Glasgow, that from October 1 the organisation will be merged with that of Messrs. Henry Wiggin & Company, Limited, and that the combined companies will be conducted from the offices in London. Whilst the administrative centre is changed to London, the manufacturing operations developed and now carried on at Cathcart will be increased at the Zenith Works, Thornliebank, where, in addition to the already established Monel-metal products, such as rods, tubes, turbine blading, etc., there will be produced tubes and drawn sections in pure nickel and other nickel alloys. The works will be operated under the name of Henry Wiggin & Company, Limited, in conjunction with the up-to-date plant in operation in their Birmingham works.

The Clyde shipbuilding industry, which has been in the doldrums since the end of last year, has obtained a new lease of life since the announcement of the contracts for Admiralty work under the 1931 programme. Messrs. William Denny Bros., Limited, Dumbarton, are to build the hull and machinery for two destroyers, Messrs. John Brown, Limited, Clydebank, the hulls and machinery for two sloops, Messrs. Fairfield Shipbuilding & Engineering Company, Limited, Govan, the machinery for one flotilla leader, the hull of which is to be built at Portsmouth, and Messrs. Scotts Shipbuilding & Engineering Company, Limited, Greenock, the hulls and machinery for two destroyers. The contracts mean something like £2,000,000 to Clydeside, and the provision of employment for about 5,000 workmen for a period extending up to two years, and a fair amount of work for the various sub-contractors, the prosperity of whose business depends on brisk times in the shipyards. Glasgow and Lanarkshire steelworks are expecting a good share of naval work, apart from what they will get through the placing of these orders for vessels in Clyde yards. The Admiralty have received tenders for armour plate, guns and other equipment, and it is confidently expected that Parkhead forge and the Lanarkshire forges will get a fair share of the contracts.

Obituary.

Mr. John Henderson died at his home at Low Biggins, Clydesdale, Bellshill, on September 24. He had been employed in the local ironworks nearly all his life until he retired a couple of years ago. He was 87 years of age.

Mr. Evelyn George Carey, A.M.I.C.E., died at his home in Uddingston, near Glasgow, on September 30, after a short illness. Mr. Carey was 75 years of age and unmarried. As an inspecting engineer well known in the foundry trade in Britain, he had many important engagements. He acted as chief inspecting engineer under William Arrol & Company, Limited, during the building of the Forth Bridge, and afterwards superintended the erection of the bridges connected with the Manchester Ship Canal. In recent years he fulfilled many engagements with corporations and municipalities.

Mr. James Frew, late mechanical superintendent engineer to the Dalmellington Iron Company, Limited, died at his residence in Ayr on September 23. Mr. Frew, who had passed his eightieth birthday, was a Lanarkshire man, born in Coatbridge and brought up at Newmains, where his father was traffic superintendent to the Coltness Iron Company, Limited, in which works he served his apprenticeship. He then emigrated to America, but returned later to Waterside to take up the position with Dalmellington Company, where he remained until his retirement a few years ago. Mr. Frew patented a slide valve which was largely used in colliery engines and locomotives.

Prof. Thomas Gray, LL.D., D.Sc., Ph.D., F.I.C., Director of the School of Chemistry and Professor of Technical Chemistry at the Royal Technical College, Glasgow, died on September 26 at Elie. Prof. Gray had been connected with the college for over 40 years. He received his early education at George Watsons College, Edinburgh, and the Andersonian College, Glasgow, where he studied under Prof. Dittmar. He went later to Jena University. In 1889 he was appointed assistant to Prof. Dittmar and later to his successor, Prof. Henderson. He graduated B.Sc., London, in 1890, and in 1893 was appointed lecturer in Chemistry at the Glasgow and West of Scotland Technical College, and also at Queen Margaret College, Glasgow. In 1900 he obtained the degree of D.Ph. at the University of Jena. In 1903 the University of Glasgow conferred upon him the degree of D.Sc. Upon the retirement of Prof. Mills in 1903 he succeeded to the Young Chair of Technical Chemistry in the Technical College, Glasgow. He was a recognised authority on fuels, and his specialised knowledge was put to good advantage during the war, when he supervised the chemical work in Scottish gasworks for the extraction of benzine and toluene for the manufacture of explosives. During the same period he carried out an extensive survey of the furnace and coking coals in Scotland with particular reference to their suitability for use in blast furnaces and the manufacture of coke. In 1913 he supervised the design and organisation of the Fuel Research Laboratories at Greenwich and for some years acted as consultant to the Fuel Research Board. Prof. Gray was an active member of many chemical and allied societies, to which he submitted many Papers on technical subjects relating particularly to the use of fuel. The University of Glasgow conferred the honorary degree of Doctor of Laws upon him in 1924. At the funeral, which took place in Elie churchyard on September 28, there was a large company of mourners representing Prof. Gray's many activities and also his colleagues on the staff of the Royal Technical College, Glasgow.

Personal.

Mr. C. L. Baillieu has been elected a director of the Imperial Smelting Corporation, Limited, in place of the Hon. W. L. Baillieu, who has resigned owing to ill-health.

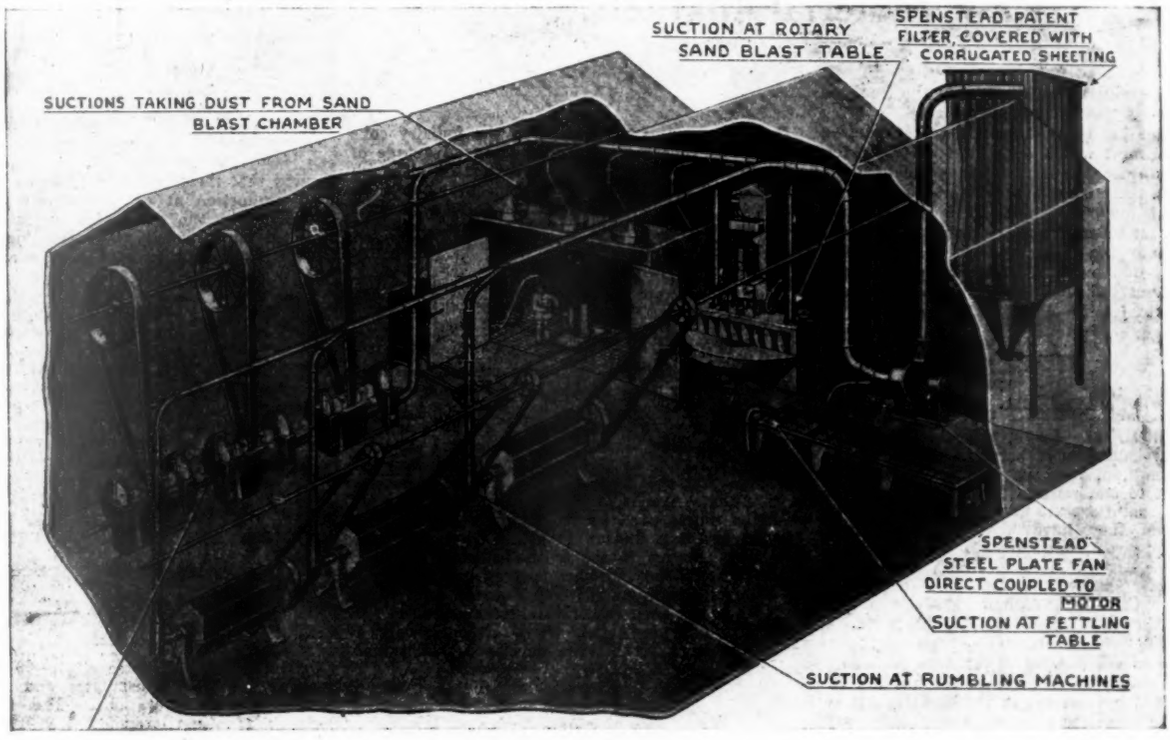
Mr. C. A. Bishop has relinquished the appointment of general manager of Davy Bros., Limited, Sheffield, and is taking up the appointment of the company's London representative.

Mr. Robert Lindsay has been made the recipient of handsome gifts from the directors of Glasgow Iron & Steel Company, Limited, on completing 60 years' service with the company. Mr. Lindsay is 74 years of age, still able to write and read without spectacles, and continues in the service of the firm.

Mr. Frank Biggin celebrated on Tuesday, September 27, the jubilee of his association with the Brightside Foundry & Engineering Company, Limited, Sheffield, of which firm he is joint managing director. He joined the firm as an office boy 50 years ago. He was elected to the board of directors in 1918, and was appointed joint managing director four years ago.

Wills.

Cochran, Oliver, of Linwood, Renfrewshire, retired ironfounder	£7,391
Pantin, Herbert, Blackheath, of W. & C. Pantin, Limited, mechanical handling specialists, London, E.C.	£18,942
Hale, W. T., a director of Messrs. Adams & Benson, Limited, iron and steel merchants, West Bromwich, the Birchley Rolling Mills, Limited, Oldbury, and of Bradley & Foster, Limited, Darlaston	£698


SUCTION AT ROTARY SAND BLAST TABLE
"SPENSTEAD" PATENT FILTER, COVERED WITH CORRUGATED SHEETING
SUCTIONS TAKING DUST FROM SAND BLAST CHAMBER
SPENSTEAD STEEL PLATE FAN DIRECT COUPLED TO MOTOR
SUCTION AT FETTLING TABLE
SUCTION AT RUMBLING MACHINES

GUTMANN SAND BLAST PLANTS are now made in ENGLAND, and when fitted with "SPENSTEAD" DUST EXTRACTION APPARATUS are the best by far in this or any other country, years ahead of any other plant.

***Makers:*—SPENCER & HALSTEAD, Ltd., OSSETT, near LEEDS.**

***Selling Agents:*—T. FEARNLEY ALLEN & SON, NORWICH UNION CHAMBERS, BIRMINGHAM.**

Part 1 NOW Ready

Part 2 will be published on October 19th.

EACH PART **1/3** net.

To be Completed in about 30 Fortnightly Parts

A COMPREHENSIVE WORK OF INSTRUCTION AND REFERENCE FOR EVERYONE CONCERNED WITH ENGINEERING IN ANY OF ITS BRANCHES

PITMAN'S ENGINEERING EDUCATOR

Edited by William J. Kearton, M.Eng., A.M.I.Mech.E. ***Assisted by Thirty-Seven Leading Specialists.***

This valuable Work, containing OVER 1,440 PAGES of instruction and information, is obtainable in Fortnightly Parts at 1/3 each Part. It has been fully revised and enlarged and is a source of expert information and reference upon all branches of engineering. This is a splendid opportunity for engineers and students to secure the work without the inconvenience of an immediate and large outlay. Order the Parts to-day.

Some of the Subjects dealt with:—

AIR COMPRESSORS, BLOWERS, AND FANS—BALL AND ROLLER BEARINGS — BLAST FURNACE PRACTICE — STEAM PLANT—CONDENSING PLANT — DRAWING OFFICE PRACTICE — ELECTROTECHNICS—ELEMENTS OF MECHANISM—ENGINEERING MATERIALS—FANS AND BOILERS—FITTING AND ERECTING—FOUNDRY PRACTICE—FUEL—GAUGING—JIGS AND TOOLS—LUBRICATION — MACHINE DRAWING — MACHINE TOOLS—MECHANICS FOR ENGINEERS — METALLURGY OF IRON AND STEEL—PATTERN MAKING AND MOULDING—PUMPS, CONSTRUCTION AND MAINTENANCE—STEAM BOILERS AND ACCESSORIES—STEAM TURBINES, DESIGN AND CONSTRUCTION—TESTING OF PRIME MOVERS—THEORY OF HEAT ENGINES—TOOTHED GEARING.

IN ABOUT THIRTY FORTNIGHTLY PARTS

ORDER FROM A NEWSAGENT **Send for FREE 8-PAGE BOOKLET, describing the Work in detail, with specimen pages and full lists of Contents and Contributors, etc.**

SIR ISAAC PITMAN & SONS, LTD., PARKER STREET, KINGSWAY, LONDON, W.C.2

Raw Material Markets.

Conditions remain much the same in the iron and steel markets. A steady volume of sales is being recorded, but as yet there is none of that expansion of forward business which seems warranted by the improvement in market sentiment. There is a possibility that those consumers who are now holding off the market may be caught by a rise in price levels in the near future. For the moment, however, hand-to-mouth buying is the general policy, especially in the pig-iron markets, as the foundries themselves cannot get sufficient forward orders for their own products to justify long-term contracting.

Pig-Iron.

MIDDLESBROUGH.—At the moment the limited output of Cleveland iron is barely matched by the rate of consumption, and the promised revival in buying has yet to materialise. It must be admitted, however, that conditions are now more favourable to a revival than they have been for some time, inquiries for pig-iron continuing to show increase, while general sentiment in trade circles is considerably improved. Prices remain unchanged, as follow:—No. 1 Cleveland, foundry grade, 61s. per ton; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s., f.o.t.

The increase in the number of furnaces producing East Coast hematite from three to six has not so far been justified by increase in the demand. It is true that the requirements of steelmakers are slightly larger, but against this there has been an intensification of price cutting, so that odd sales of mixed numbers have been reported at 58s. 6d. for mixed numbers, although the official quotation remains 60s. per ton. On the West Coast, Bessemer mixed numbers are maintained at 66s. per ton at works.

LANCASHIRE.—Business in foundry iron in this area is disappointingly slow at the moment. Replacement contracts are coming forward more tardily than usual, and a month-to-month basis seems to be as far as most consumers will go. New business is almost non-existent. For delivery to users in the Manchester price zone, Midland brands—Staffordshire and Derbyshire No. 3—are on offer on the basis of 67s. per ton, with North-East Coast iron at about the same figure, Northants at 65s. 6d., Derbyshire forge at 62s., Scottish No. 3 at about 84s., West Coast hematite iron at around 81s. and Indian pig-iron at from 67s. to 75s. per ton, according to grade.

MIDLANDS.—The ironfounders in this area are experiencing a temporary dearth of business owing to the slackness of conditions at the foundries, particularly in the heavy engineering section. There was a meeting of the Central Pig-iron Producers' Association at Birmingham last Thursday, but prices were unchanged, remaining at the controlled levels of 62s. 6d. for Northants No. 3, and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3, including delivery to Birmingham and Black Country stations.

SCOTLAND.—The continued poor demand for their own products gives the foundries little inducement to buy supplies of pig-iron. Short time is almost the general rule at those works that are not already closed down. The price of 67s. 6d. for No. 3 Scottish foundry iron, f.o.t. furnaces, remains in force. No. 3 Middlesbrough is still offered at 55s. 6d. per ton f.o.t. Falkirk and Midland irons at about 54s. per ton.

Coke.

Business remains very quiet in the foundry coke market and consumers are not taking advantage of offers of forward contracts at present rates, although the time is now overdue for them to make their customary seasonal purchases. Quotations for best Durham fuel range from 36s. 9d. to 38s., delivered Birmingham and district, with Welsh makes at 30s. to 45s., according to analysis.

Steel.

In the semi-finished steel department, business has declined, as most of the big consumers are reported to be well covered. The greater part of the current business in semis appears to be going to British producers. Business in Continental material is very restricted, as there is some anticipation in the trade that the present duties will be increased or the quota system applied to foreign material when the duties come up for review at the end of October, and it is difficult to obtain delivery before that time. Buying in the finished-steel department is also quieter, but specifications against contracts are being received more freely than of late. The home trade has been rather brighter and export inquiry also has been fairly good, although only a small proportion of this has developed into actual business.

Scrap.

In the Cleveland area there is a fair demand for scrap iron and prices are unchanged. Similar conditions prevail in the Midlands, where heavy machinery metal is offered at 42s. 6d. to 45s. and clean light at 35s. In South Wales, however, the price of heavy cast iron has fallen to 39s. to 40s., owing to a weak demand, while there is also little call for good heavy cast-iron machinery scrap at 45s. to 46s. 6d.

Metals.

Copper.—The price of this metal is barely maintained by the limited demand from the consuming industries. The chief factor in the situation at present is the possibility of the Government ratifying the import duty of 2d. per lb. on foreign metal promised to the Empire producers at the Ottawa Conference. It is assumed that the necessary steps will be taken upon the re-assembly at Westminster, although there is a growing reaction against the policy of taxing imports of essential raw materials.

Closing quotations :—

Cash.—Thursday, £34 11s. 3d. to £34 12s. 6d.; Friday, £34 to £34 1s. 3d.; Monday, £33 13s. 9d. to £33 15s.; Tuesday, £33 5s. to £33 7s. 6d.; Wednesday, £33 12s. 6d. to £33 13s. 9d.

Three Months.—Thursday, £34 12s. 6d. to £34 13s. 9d.; Friday, £34 2s. 6d. to £34 3s. 9d.; Monday, £33 16s. 3d. to £33 17s. 6d.; Tuesday, £33 6s. 3d. to £33 8s. 9d.; Wednesday, £33 13s. 9d. to £33 15s.

Tin.—The outlook in the tin market continues to improve. Stocks held in this country are steadily passing into consumption, owing to the increased measure of activity in the consuming industries, particularly the tinplate industry.

Official closing prices :—

Cash.—Thursday, £153 5s. to £153 10s.; Friday, £151 15s. to £152; Monday, £150 to £150 5s.; Tuesday, £151 5s. to £151 10s.; Wednesday, £151 5s. to £151 10s.

Three Months.—Thursday, £154 15s. to £155; Friday, £153 5s. to £153 7s. 6d.; Monday, £151 12s. 6d. to £151 17s. 6d.; Tuesday, £152 10s. to £152 15s.; Wednesday, £152 12s. 6d. to £152 15s.

Spelter.—Although, for technical reasons, prompt supplies become temporarily rather scarce in the last few days of September, consumers may be assured that there is plenty of metal available, even with production at its present low level. Should conditions in the consuming industries show the expected improvement, the restrictions upon output will in all probability be shortly relaxed.

Daily fluctuations :—

Ordinary.—Thursday, £15 5s.; Friday, £15 10s.; Monday, £15 2s. 6d.; Tuesday, £15 1s. 3d.; Wednesday, £15 5s.

Lead.—There is a fair demand from consumers, but insufficient to keep the market moving steadily, and prices continue to fluctuate in accordance with the conditions on Wall Street, etc. In this, as in the other base metal markets, everything rests upon the promised improvement in the finishing industries.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £12 17s. 6d.; Friday, £12 18s. 9d.; Monday, £12 11s. 3d.; Tuesday, £12 8s. 9d.; Wednesday, £12 13s. 9d.

Contracts Open.

Dunedin, N.Z., November 11.—50 tons of steel tramway rails, with fishplates and bolts, for the Dunedin City Corporation. The Department of Overseas Trade. (Reference G.X. 11,842.)

Galioub, Egypt, November 10.—Construction and equipment of waterworks, for the Egyptian Ministry of the Interior (Municipalities and Local Commissions Section). The Department of Overseas Trade. (Reference G. 11,888.)

Johannesburg, October 24.—Mild-steel rivets, for the South African Railways and Harbours Board. The Department of Overseas Trade. (Reference G. 11,839.)

Plymouth, October 11.—6,000 yds. of 9-in., 6-in., 4-in. and 3-in. cast-iron or spun pipes, for the Town Council. Mr. F. Howarth, water engineer, Stonehouse Town Hall, Plymouth.

New Companies.

Pilot Stainless Steel Company, Limited.—Capital £500. Solicitors: Slater & Elliott, 39, Bank Street, Sheffield.

C. P. Marrison, Limited.—Capital £5,000. Steel and file manufacturers. Director: C. P. Marrison, Sunnyside, Hathersage, Derbyshire.

Milford Priestley, Limited.—Capital £4,000. Stove manufacturers. Directors: M. Priestley, 17, Bell Hall Mount, Halifax, and J. Haigh.

Giant Airship Hangar in America.—When the new airship hangar, at Sunnyvale, California, is completed, more than seven miles of welding will have gone into its construction. The dimensions of this giant structure, which is to house the new U.S. Navy dirigible "Macon," will be about 1,200 ft. in length by 308 ft. in width by 225 ft. in height. Not only will this hangar be one of the largest buildings in the world, but it will be the largest building in the world without pillars or posts to support it. The hangar, which will be in the shape of an enormous elongated archway, will have the world's largest single unobstructed floor area, nearly 300,000 sq. ft.—"American Metal Market."

GRAPHITE ELECTRODES OF UNIFORM HIGH QUALITY FOR THE PRODUCTION IN THE ELECTRIC ARC FURNACE OF ALL KINDS OF STEELS, GREY IRON, ZINC, BRASS, ETC.

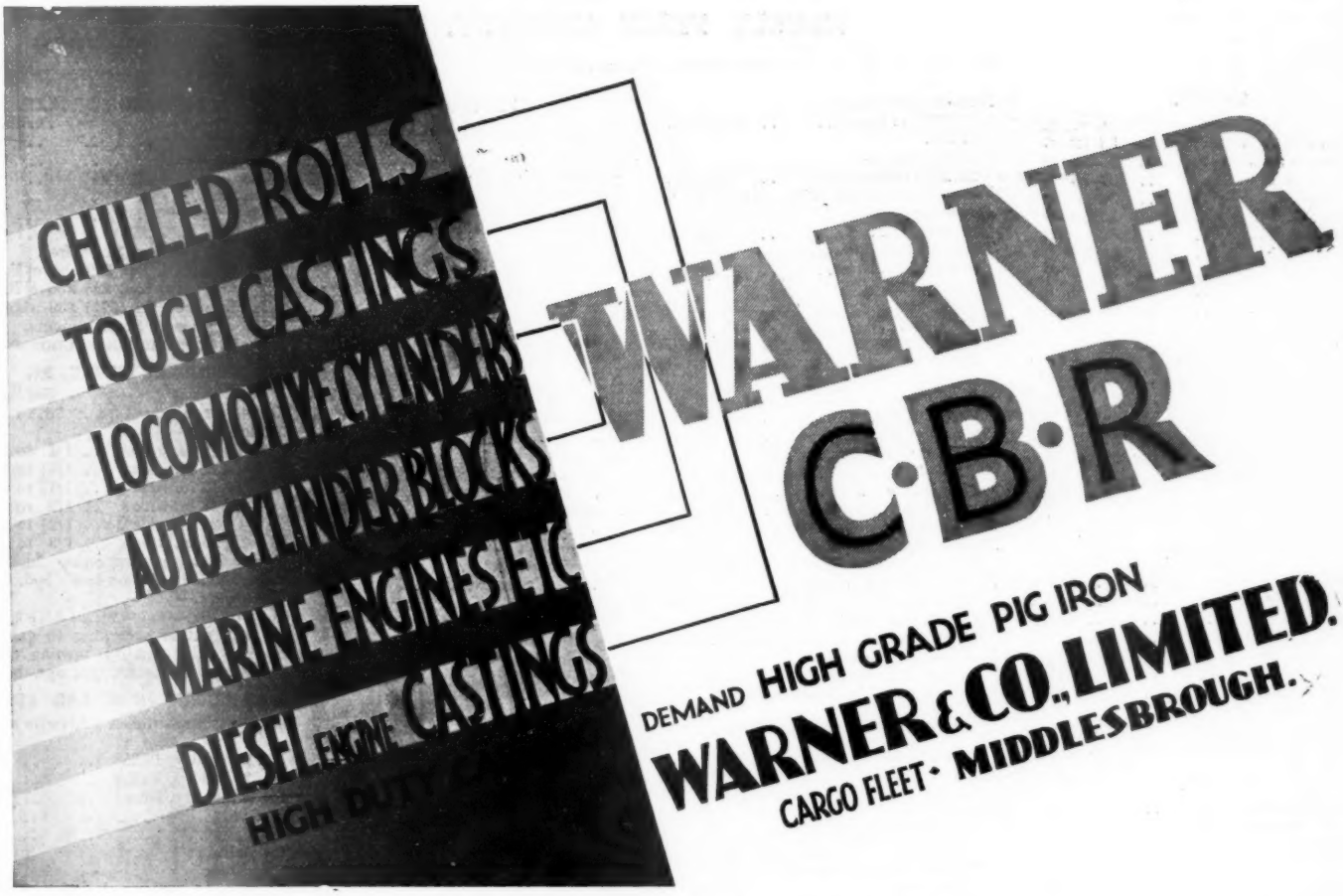
ACHESON ELECTRODES

WRITE FOR INFORMATION TO:

E. G. ACHESON, LTD.,

40, WOOD STREET, WESTMINSTER, S.W.1

Telephone: VICTORIA 5646 (4 lines). Telegrams: OILDAG, PARL, LONDON.



CAST IRON FLANGED PIPES

2 in.–12 in. & CONNECTIONS. to 24 in. dia.

WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.

JAMES & RONALD RITCHIE, LTD.,

Telephone: 3852 (2 Lines). **MIDDLESBROUGH.** Telegrams: "Ritchie, Middlesbrough."

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	33	12	6
Three months	33	13	9
Electrolytic	37	15	0
Tough	35	0	0
Best selected	35	10	0
Sheets	68	0	0
India	45	10	0
Wire bars	38	0	0
Do., Nov.	38	0	0
Do., Dec.	38	0	0
Ingot bars	38	0	0
H.C. wire rods	41	0	0
Off. av. cash, September	35	0	7 3/4
Do., 3 mths., September	35	1	1 7/11
Do., Sttlmnt., September	35	0	6 9/11
Do., Electro, September	38	13	2 2/11
Do., B.S., September	37	4	2
Do., wire bars, September	39	0	0
Solid drawn tubes			10½d.
Brazed tubes			10½d.
Wire			7d.

BRASS.

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7¾d.
Wire	7¾d.
Rolled metal	7¾d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¼d.

TIN.

	£	s.	d.
Standard cash	151	5	0
Three months	152	12	6
English	153	0	0
Bars	155	0	0
Straits	157	5	0
Australian	156	5	0
Eastern	155	5	0
Banca	158	5	0
Off. av. cash, September	152	16	3
Do., 3 mths., September	154	7	7 4/11
Do., Sttlmt., September	152	16	1 7/11

SPELTER.

	£	s.	d.
Ordinary	15	5	0
Remelted	15	0	0
Hard	12	15	0
Electro 99.9	17	10	0
English	16	2	6
India	14	10	0
Zinc dust	22	0	0
Zinc ashes	2	5	0
Off. aver., September	15	10	8 23/44
Aver. spot, September	15	9	1 7/11

LEAD.

	£	s.	d.
Soft foreign ppt.	12	13	9
Empire	12	18	9
English	14	10	0
Off. average, September	13	4	8 13/22
Average spot, September	13	2	5 7/11

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex-whse.	22	10	0
Rods	27	0	0
Boiler plates	23	0	0
Battery plates		—	

ANTIMONY.

	£	s.	d.	£	s.	d.
English	35	0	0 to	42	10	0
Chinese				25	0	0
Crude				16	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	9	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£8 0 0
45/50%	£13 15 0
75%	£19 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free of Mo.	6/3 per lb.
Ferro-titanium—	
23/25% carbon-free	10½d. lb.
Ferro-phosphorus, 20/25%	£21 0 0
Ferro-tungsten—	
80/85%	1/9 lb.
Tungsten metal powder—	
98/99%	2/- lb.
Ferro-chrome—	
2/4% car.	£34 5 0
4/6% car.	£25 15 0
6/8% car.	£24 10 0
8/10% car.	£22 5 0
Ferro-chrome—	
Max. 2% car.	£37 5 0
Max. 1% car.	£44 10 0
Max. 0.70% car.	£45 17 6
70% carbon-free	1/- lb.
Nickel—80/99.5%	£240 to £245
"F" nickel shot	£216 0 0
Ferro-cobalt	7/9 lb.
Aluminium 98/99%	£100 0 0
Metallic chromium—	
96/98%	2/9 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese—	
94/96% carbon-free	1/4½ lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten 2s. 0d.
Finished bars, 18% tungsten 2s. 9d.
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares, 3 in. and over 4d. lb.
Rounds and squares, under ½ in. to ¼ in. 3d. lb.
Do., under ¼ in. to 7/16 in. 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in. 3d. lb.
Do., under ½ in. × ¼ in. 1/- lb.
Bevels of approved sizes and sections 6d. lb.
Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	1	18	0 to	1	19	0
Bundled steel and shrngs.	1	15	0 to	1	18	0
Mixed iron and steel	1	15	0 to	1	16	0
Heavy cast iron	1	19	0 to	2	0	0
Good machinery	2	5	0 to	2	6	6
Cleveland—						
Heavy steel	1	12	6 to	1	15	0
Steel turnings				1	7	6
Cast-iron borings				1	2	6
Heavy forge				2	10	0
W.I. piling scrap				2	2	6
Cast-iron scrap	1	15	0 to	1	16	0
Midlands—						
Light cast-iron scrap				1	15	0
Heavy wrought iron				2	2	6
Steel turnings, f.o.r.				0	19	0
Scotland—						
Heavy steel				1	13	0
Ordinary cast iron				2	0	0
Engineers' turnings				1	7	6
Cast-iron borings				1	10	0
Wrought-iron piling				1	19	6
Heavy machinery				2	5	6

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	26	0	0
Brass	19	0	0
Lead (less usual draft)	11	10	0
Tea lead	10	0	0
Zinc	8	10	0
New aluminium cuttings	72	0	0
Braziery copper	23	0	0
Gunmetal	20	0	0
Hollow pewter	62	0	0
Shaped black pewter	65	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	60/6
Hematite M/Nos.	60/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	70/-
" d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs No. 4 forge*	61/-
" No. 3 fdry.*	66/-
Shrops basic	—
" Cold blast, ord.	—
" " roll iron	—
Northants forge*	57/6
" fdry. No. 3*	62/6
" fdry. No. 1*	65/6
Derbyshire forge*	61/-
" fdry. No. 3*	66/-
" fdry. No. 1*	69/-
" basic*	—
*d/d Black Country dist.	
Scotland—	
Foundry No. 1	70/-
" No. 3	67/6
Hem. M/Nos. d/d	67/6
Sheffield (d/d district)—	
Derby forge	58/6
" fdry. No. 3	63/6
Lincs forge	—
" fdry. No. 3	63/6
E.C. hematite	73/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
" fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	84/-
Clyde, No. 3	84/-
Monkland, No. 3	84/-
Summerlee, No. 3	84/-
Eglinton, No. 3	84/-
Gartsherrie, No. 3	84/-
Shotts, No. 3	84/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	9	5	0 to	9	15	0
Nut and bolt iron	7	15	0 to	8	10	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.				12	0	0
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	7	6 to	9	5	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ¾ in. (Untested)			6 12	6	& up.	
Flats—8 in. wide and over				8	12	6
" under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	0	0
Hoops (Staffs)				9	10	0
Black sheets, 24g.	8	0	0 to	8	10	0
Galv. cor. shts.				10	0	0
Galv. flat shts.				11	0	0
Galv. fencing wire, 8g. plain				12	15	0
Billets, soft	4	17	6 to	5	7	6
Billets, hard				6	12	6
Sheet bars	4	15	0 to	5	5	0
Tin bars				4	15	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10¾d.
Sheet to 10 w.g.	11¾d.
Wire	12d.
Rods	10¾d.
Tubes	16¼d.
Castings	12¾d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	13.84
No. 2 foundry, Valley	14.50
No. 2 foundry, Birm.	11.00
Basic	15.38
Bessemer	16.89
Malleable	16.39
Grey forge	16.39
Ferro-mang. 80%, seaboard	68.00
O.-h. rails, h'y, at mill	43.00
Billets	26.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.55
Sheets, black, No. 24	2.10
Sheets, galv., No. 24	2.75
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	20/- to 22/6
" furnace	16/- to 16/6
Durham and Northumberland—	
" foundry	21/- to 25/-
" furnace	12/- to 12/6
Midlands, foundry	—
" furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		16/-
"	28×20 "		32/-
"	20×10 "		23/6
"	18¾×14 "		16/3
C.W.	20×14 "	13/3 to	13/6
"	28×20 "		—
"	20×10 "		—
"	18¾×14 "		—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0 to	£7	0	0
Bars-hammered, basis	£16	10	0 to	£17	0	0
Bars and nail-rods, rolled, basis	£15	17	6 to	£16	5	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£32	0	0 to	£33	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£ s. d.	
Sept.	29 ..	34 11 3	dec. 1/3
,,	30 ..	34 0 0	,, 11/3
Oct.	3 ..	33 13 9	,, 6/3
,,	4 ..	33 5 0	,, 8/9
,,	5 ..	33 12 6	inc. 7/6

Electrolytic Copper.

		£ s. d.	
Sept.	29 ..	38 10 0	No change
,,	30 ..	38 10 0	,, ,,
Oct.	3 ..	38 0 0	dec. 10/-
,,	4 ..	37 10 0	,, 10/-
,,	5 ..	37 15 0	inc. 5/-

Standard Tin (cash).

		£ s. d.	
Sept.	29 ..	153 5 0	dec. 5/-
,,	30 ..	151 15 0	,, 30/-
Oct.	3 ..	150 0 0	,, 35/-
,,	4 ..	151 5 0	inc. 25/-
,,	5 ..	151 5 0	No change

Tin (English ingots).

		£ s. d.	
Sept.	29 ..	155 0 0	dec. 5/-
,,	30 ..	153 15 0	,, 25/-
Oct.	3 ..	148 5 0	,, 110/-
,,	4 ..	153 0 0	inc. 95/-
,,	5 ..	153 0 0	No change

Spelter (ordinary).

		£ s. d.	
Sept.	29 ..	15 5 0	dec. 1/3
,,	30 ..	15 10 0	inc. 5/-
Oct.	3 ..	15 2 6	dec. 7/6
,,	4 ..	15 1 3	,, 1/3
,,	5 ..	15 5 0	inc. 3/9

Spelter (Electro, 99.9 per cent.).

		£ s. d.	
Sept.	29 ..	17 10 0	No change
,,	30 ..	17 15 0	inc. 5/-
Oct.	3 ..	17 10 0	dec. 5/-
,,	4 ..	17 10 0	No change
,,	5 ..	17 10 0	,, ,,

Zinc Sheets (English).

		£ s. d.	
Sept.	29 ..	24 10 0	No change
,,	30 ..	24 10 0	,, ,,
Oct.	3 ..	24 10 0	,, ,,
,,	4 ..	24 10 0	,, ,,
,,	5 ..	24 10 0	,, ,,

Lead (English).

		£ s. d.	
Sept.	29 ..	14 15 0	No change
,,	30 ..	14 15 0	,, ,,
Oct.	3 ..	14 10 0	dec. 5/-
,,	4 ..	14 10 0	No change
,,	5 ..	14 10 0	,, ,,

AVERAGE MONTHLY PRICES OF MARKED BARS (SOUTH STAFFS).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1898	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	8 0 0	8 0 0	7 11 8
1899	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 10 0	9 0 0	9 0 0	9 10 0	10 0 0	10 0 0	10 0 0	8 8 4
1900	11 0 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 5 10
1901	9 10 0	9 10 0	9 10 0	9 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 16 8
1902	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 7 6
1903	8 5 0	8 5 0	8 5 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 8 9
1904	8 10 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 10
1905	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 10 0	8 1 8
1906	8 10 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	8 10 0	8 10 0	8 10 0	8 10 0	9 0 0	8 15 10
1907	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0
1908	9 0 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 5 10
1909	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1910	8 0 0	8 0 0	8 0 0	8 0 9	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1911	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1912	8 10 0	8 10 0	8 10 0	8 15 0	9 0 0	9 0 0	9 0 0	9 8 0	9 10 0	9 10 0	9 10 0	9 15 0	9 1 6
1913	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	9 10 0	9 10 0	9 4 0	9 0 0	9 0 0	9 13 8
1914	8 12 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	8 14 4
1915	9 0 0	9 0 0	9 3 0	10 2 0	10 15 0	11 10 0	12 0 0	12 0 0	12 0 0	12 7 6	12 10 0	13 10 0	11 5 0
1916	13 10 0	13 10 0	14 13 0	15 0 0	15 0 0	15 0 0	15 0 0	15 10 0	15 10 0	15 0 0	15 10 0	15 0 0	14 18 7
1917	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0
1918	15 12 6	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	17 0 0	17 0 0	17 0 0	16 6 3
1919	18 0 0	18 10 0	20 0 0	20 0 0	23 0 0	23 0 0	23 0 0	24 12 0	25 0 0	25 0 0	25 0 0	25 5 0	22 10 7
1920	26 17 6	27 0 0	28 0 0	30 5 0	30 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	31 10 2
1921	31 10 0	30 3 4	27 10 0	27 10 0	27 10 0	24 15 0	21 0 0	20 0 0	20 0 0	17 10 0	17 0 0	16 0 0	23 7 4
1922	16 0 0	14 17 6	14 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 18 1½
1923	13 10 0	13 10 0	13 16 0	14 7 6	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 5 3½
1924	14 10 0	14 10 0	14 10 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 17 6	14 17 3½
1925	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 0 0	14 18 4
1926	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	*	14 10 0	14 0 10
1927	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 0 0	13 0 0	12 18 0	13 15 8
1928	12 10 0	12 10 0	12 10 0	12 2 6	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 2 8½
1929	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 7 6	12 10 0	12 10 0	12 2 3½
1930	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1931	12 10 0	12 10 0	12 10 0	12 8 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 3 2
1932	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	—	—	—	—

* No quotation available.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS WANTED.

BRASS FOUNDRY FOREMAN desires position; experienced in Admiralty contracts, gunmetal, phos. bronze and manganese castings; 12 years foreman in last situation.—Box 258, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

REPRESENTATIVE, North of England, connection foundries, iron and steel works, shipyards, N.E. Coast, desires position good firm, preferably salary, commission, expenses basis.—Box 270, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of The Foundry Trade Journal.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

POSITION required as Foreman or Assistant Foreman, by young Moulder with good experience in general Engineering Foundries, including Iron, Steel, Malleable and Non-ferrous. City and Guilds Diploma. (192)

PROPERTY.

MAGNIFICENT

11 ACRES WORKS SITE.

SHEFFIELD.

145,000 Sq. Ft. of Shops.

SIDING CONNECTIONS

with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,

ALBION WORKS, SHEFFIELD.

BRASS Foundry (small) for Sale; a real opportunity for a live man who wants to make money; well equipped, good clients, and plenty of orders; very cheap for quick sale.—Write, Box 268, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

PATENTS.

PICKLING METALS.—The Proprietors of Patent No. 334418, for "Improvements in and relating to Processes for Pickling Metals and to Materials used therefor," are desirous of entering into arrangements with manufacturers or other interested parties for manufacture and exploitation of the invention in the United Kingdom on reasonable terms.—For particulars apply to Fell & James, 11, Queen Victoria Street, London, E.C.4.

PATENTS—*Continued.*

THE Proprietors of Patent No. 279413, for "Improvements in or relating to Cover Plates, the Tread Surfaces of which are designed to Prevent Persons from Slipping when Walking on them," are desirous of entering into arrangements by way of licence and otherwise on reasonable terms for purpose of exploiting same and ensuring its full development and practical working in this country.—Address all communications in first instance Haseltine, Lake & Company, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

MACHINERY.

TITAN CUPOLETTE, complete with fan and pipes, equal to new, £30.—A. Hammond, 14, Australia Road, Slough.

'Phone 287.

FOR Sale.—Two Ajax No. 9 Pneumatic P.D. MOULDING MACHINES.
One Harvey Size 4 Portable Aluminium FURNACE complete with Fan.
Two SAND MILLS.
One Pneulec Rotary SAND DRYER.
Three Titan CUPOLAS, 4 to 5 and 5 to 6 tons per hour.
One Hydraulic PUMP, 3-throw, single-acting.
One Denbigh No. 3 Turnover MOULDING MACHINE.
Band Saw. Grinding Spindles, Portable Grinders, Ladles, Moulding Boxes, all sizes, etc.
Alfred Wiseman, Limited,
Glover Street, Birmingham.

TILGHMAN Sand-blast Room, 12 ft. x 9 ft., in C.I. Sections.
Tilghman Rotary Barrel Sand-blast Plant, 36 in. x 30 in. Complete with Tilghman B.H. 4½ Compressor.
Macdonald No. 9 "Ajax" Pneumatic Jarr Turnover P.D. Moulding Machine.
Fordath "Senior" Rotoil Core Sand Mixer.
Pneulec Royer No. 1 Sand Mixer.
Pridmore Rockover Portable Moulding Machine.
Twenty Adaptable Moulding Machines.
Tabor Pneumatic Split Pattern Squeezer. New.
No. 1 Britannia Jolters.
Tabor Pneumatic Portable Rollover Moulding Machine.
Jackman 2-ton Geared Ladle. New.
K.B. Electric Blowers, 220 volts D.C., 6-in. and 8-in. outlet. New.
Numerous other items of Foundry Plant, also Air Compressors and Electric Motors, in stock. ALL AT LOW PRICES.
Send your inquiries to :—S. C. Bilsby, A.M.I.C.E., 215, Barclay Road, Warley, near Birmingham. 'Phone: Bearwood 1103.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.

Carries a large stock of **FOUNDRY PLANT** which, generally, includes :—

Power and Hand Moulding Machines, Sand Mills and Disintegrators, Sand Blast Plants, Ladles, Melting Furnaces, Grinding Machines, Blowers and Exhaust Fans, Air Compressors, etc., etc.

Also 300 A.C. and D.C. Electric Motors, ¼ to 200 h.p., and Generators, to suit most systems.

All at low prices. Please send your inquiries to :—

215, BARCLAY ROAD, WARLEY,
Nr. Birmingham.
'Phone: Bearwood 1103.

WORKS ADDRESS: Crosswells Road (next G.W.R. level crossing), Langley, near Birmingham. 'Phone: Broadwell 1359.

THOS. W. WARD, LTD.

3" Port. Petrol Dr. Diaphragm Pumping Set, cap. 4,500 galls. per hr.
Hori. 3-throw Hyd. Pumps, 4½" rams x 15" str., 1,500 lbs. press.
15-ton No. 20 Inclinable Power Press, by Rhodes.
Rotary Briquetting Press, table 3' dia., cap. 4' balls.

ALBION WORKS, SHEFFIELD.
'Grams: Forward. 'Phone, 23001 (10 lines).
"Albion" Catalogue on application.

MISCELLANEOUS.

REDUCTIONS IN PRICES have taken place of a number of our articles for Foundry Supplies. Therefore be not guided by our previous lists, but send for our latest.—William Olsen, Limited, Cogan Street, Hull.

THE "NEILD SAFETY FIRST BOOT," Prov. Pat. 8580, is specially designed to protect the feet from molten metal, sand, etc. Stocked in three grades.—Prices on application from G. Neild, Hough End, Bramley, Leeds.

P.P.P.P. stands for our PERFECT PEERLESS PARTING POWDER. Cheapest and best. Always ready in casks or paper-lined bags (free), carriage paid any distance.—William Olsen, Limited, The Foundry Suppliers, Hull.

'Phone: 287 SLOUGH

SAND PLANT

"Rotoil" Oilsand mixer, large size	£60
"Spermolin" paddle-blade Oilsand mixer, large size	£18
"Herbert" Sand disintegrator ...	£32
"Brealey" Sand disintegrator (new)	£24

Several Sandmills; Ladles—All Sizes

PNEUMATIC MACHINES

14"×16" Mumford split pattern 2@	£30 each
18"×18" Tabor split pattern ...	£40
30"×20" Macdonald jolt rollover...	£60
20"×16" Macdonald jolt rollover...	£40
72"×72" Macdonald plain jolter, 16" cylinder	£90

Every Machine overhauled and retested.

BUY FROM ME AND SAVE MONEY!

Alex. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

BRISTOL

To Engineers, Founders, Manufacturers. Fine site of nearly 3 acres on Arterial Road with Foundry and Workshops and own Rail Sidings into premises. Modern Offices, Warehouse and Workrooms. Central Heating.
CHARLES A. TRICKS & SON,
Auctioneers,
ST. NICHOLAS STREET, BRISTOL.

Bradley's

REFINED ALLOY IRONS

A new range of compositions containing varying proportions of Nickel, Chromium, Vanadium, Titanium, etc., suitable for wear and corrosion resistance, castings required to withstand high temperature, acid resistance and for high strength, toughness and resilience qualities. The use of Alloy Pig Irons ensures homogeneous castings, avoids segregation and ladle losses and gives 100% benefit from alloy additions.

BRADLEY & FOSTER LIMITED
DARLASTON BLAST FURNACES,
DARLASTON, STAFFS

Telephone: Darlaston 16 (P.B. Ex.) Telegrams: "Bradley's, Darlaston."